Fecal Coliform TMDL Fecal Coliform TMDL Development for Three Segments in the Choctawhatchee River Watershed, Florida

Choctawhatchee River (2)

Sikes Creek

Final

USEPA Region 4
61 Forsyth Street
Atlanta, GA 30303

February 2001

CHOCTAWHATCHEE RIVER (2 Segments) and SIKES CREEK
TOTAL MAXIMUM DAILY LOAD (TMDL) SUMMARY

NOTE: THESE FECAL COLIFORM TMDLs REQUIRE *NO LOAD REDUCTIONS* OVER CURRENT CONDITIONS TO MEET WATER QUALITY STANDARDS
(IN ALL CASES THE LOAD ALLOCATION (LA) IS EQUAL TO THE TOTAL EXISTING LOAD IN THE WATERSHED)

By definition: TMDL = WLAs + LAs + MOS

In terms of **concentration**:

Wasteload Allocation (WLA) = 0 fecal coliforms /100 ml
Load Allocation (LA) [+ Future Activities (Fut)] = 190 fecal coliforms /100 ml
Margin of Safety - explicit (MOS) = 10 fecal coliforms /100 ml

TMDL = WLA + LA + MOS + Fut = **200 fecal coliforms /100 ml**

In terms of **load**:

Sikes Creek -- Map ID 27
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 9.5E+13 fecal coliforms/30 days
Margin of Safety (MOS) = 4.6E+12 fecal coliforms/30 days
Reserve for Future Growth/Activities = 3.90E+11 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **10.0E+13 fecal coliforms/30 days**

Choctawhatchee River -- Map ID 24
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 9.33E+16 fecal coliforms/30 days
Margin of Safety (MOS) = 4.9E+15 fecal coliforms/30 days
Reserve for Future Growth/Activities = 7.05E+12 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **9.82E+16 fecal coliforms/30 days**

Choctawhatchee River Map -- ID 14
Wasteload Allocation (WLA) = 0 fecal coliforms /day
Load Allocation (LA) = 4.64E+15 fecal coliforms/30 days
Margin of Safety (MOS) = 2.3E+14 fecal coliforms/30 days
Reserve for Future Growth/Activities = 1.10E+13 fecal coliforms/30 days
TMDL = WLA + LA + MOS = **4.88E+15 fecal coliforms/30 days**

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TABLES

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1.0 INTRODUCTION

COMPANION REPORT

This is one of two TMDL reports prepared at this time for the Choctawhatchee watershed in Florida. The companion report is titled, "Fecal Coliform TMDL for Four Segments in the Choctawhatchee River Watershed, Florida – Alligator Creek, Bruce Creek, Camp Branch, Fish Branch."

PURPOSE

Levels of coliform bacteria can become elevated in waterbodies as a result of both point and nonpoint sources of pollution. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies that are not meeting designated uses even though sources have implemented technology-based controls. A TMDL establishes the allowable load of a pollutant or other quantifiable parameter based on the relationship between pollutant sources and in-stream water quality. A TMDL provides the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

The headwaters of the 5,362-square mile (mi^2) Choctawhatchee River watershed are in southern Alabama, while the remainder of the watershed lies within the panhandle of northwest Florida. The river and its tributaries traverse five counties in Florida (Bay, Holmes, Jackson, Walton, and Washington) and nine in Alabama (Pike, Barbour, Coffee, Dale, Geneva, Houston, Henry, Covington, and Bullock) (Figure 1-1). It is the fourth largest river in Florida in terms of flow and drainage area. The Choctawhatchee River is designated for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife (Class III). The Choctawhatchee River is also afforded special protection under Chapter 62-302.700 because it is designated as a Special Water.

The Choctawhatchee River system has historically supported a rich and diverse ecology and is a proven substantial economic, recreational, and aesthetic resource for northwest Florida residents and visitors. For many years, however, the system has been used as a "sink" for nonpoint source pollution and wastewater treatment plant effluent (NWFWMD, 1996). The objective of this study is to develop TMDLs for segments of the Choctawhatchee River system that have been identified on Florida's 303(d) list as impaired because of exceedances of Florida's water quality standard for fecal coliform bacteria.

Eight segments of the Choctawhatchee River and its tributaries have been placed on Florida's 1998 303(d) list as fecal coliform-impaired waterbodies by the Florida Department of Environmental Protection (FDEP). This impairment has resulted in non-attainment of designated uses, including recreation, for Bruce Creek, Camp Branch, Alligator Creek, Sikes Creek, Fish Branch, and three segments on the mainstem of the Choctawhatchee River. The objective of this study is to develop TMDLs for fecal coliform for three of the eight 303(d)-listed segments in the Choctawhatchee River watershed, including Sikes Creek and two sections of the Choctawhatchee River (upstream and downstream segments). The tidal reach of the Choctawhatchee River will be addressed at a later date.

Section 2 characterizes the study area, describes the designated uses associated with the resource, and identifies physical and land use characteristics. Section 3 inventories and evaluates relevant water quality data for the Choctawhatchee watershed. Section 4 identifies and characterizes the sources of fecal coliform within the Choctawhatchee River watershed. Section 5 presents the modeling and analysis methodologies used to link source loading and water quality response. Section 6 presents the elements of the TMDLs for Sikes Creek and the Chocatwhatchee River (upstream and downstream segments), which are listed segments in the Choctawhatchee River watershed.

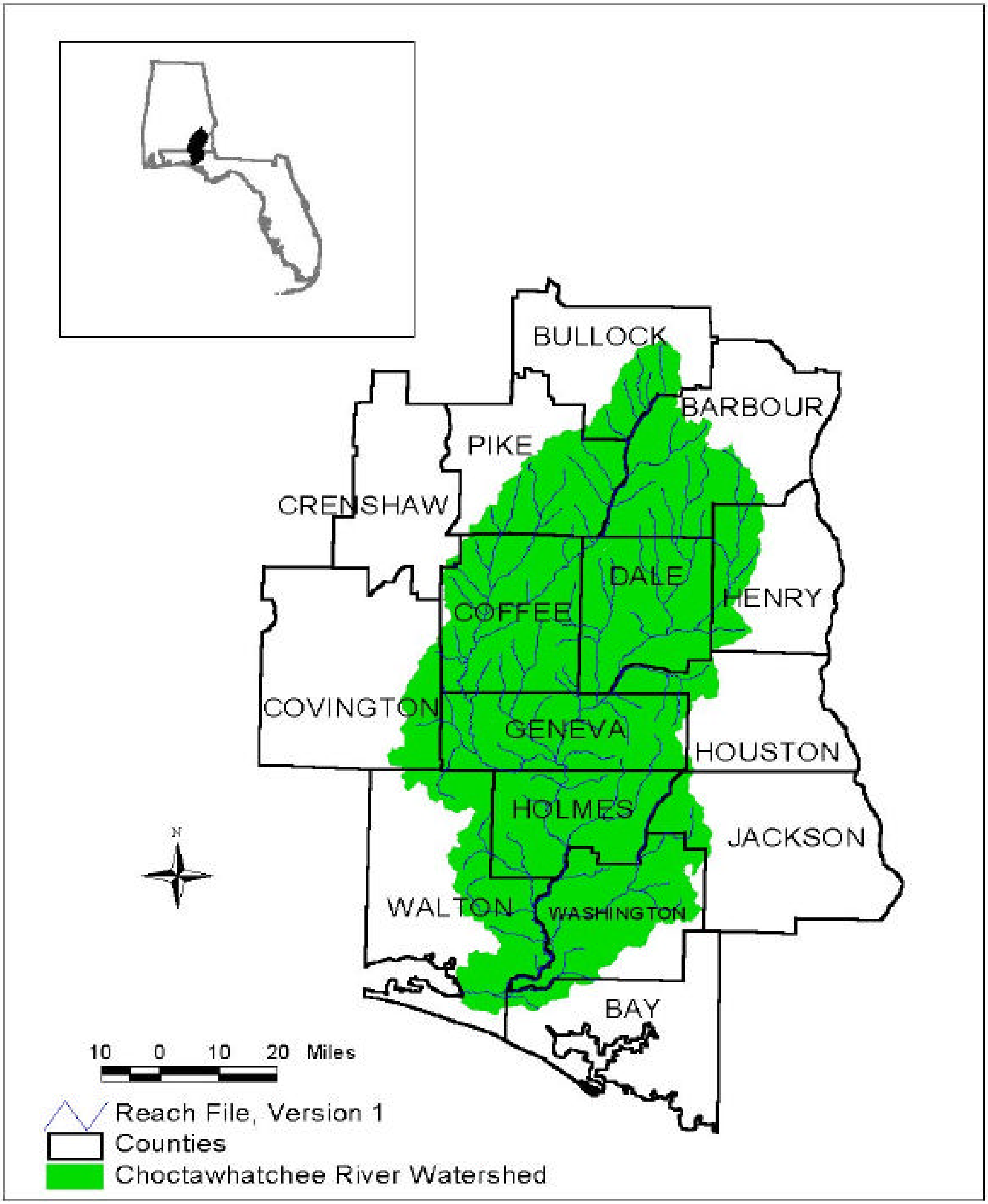

Figure 1-1. Location of the Choctawhatchee River Watershed

2.0 PHYSICAL CHARACTERISTICS

The purpose of this section is to characterize the Choctawhatchee River watershed by identifying existing land uses, soils, topography, ecology, and land and resource management activities, as well as describing the water quality standards associated with this resource.

2.1 STUDY AREA

The three listed segments are located within the Choctawhatchee River watershed, a drainage basin of approximately 5,362 mi^2. Approximately 41 percent (2,193 mi^2) of this total area is located in Florida (NWFWMD, 1996). The Choctawhatchee River originates in southern Alabama, and flows about 89 miles from the Florida-Alabama line to Choctawhatchee Bay (Hand, Col, and Lord, 1996). It is the fourth largest river in Florida in terms of flow and drainage area, with an average annual discharge of 7,198 cubic feet per second (cfs). Principal tributaries include the Pea River in Alabama and Holmes, Wrights, Sandy, Pine Log, Seven Run, and Bruce creeks in Florida. The Choctawhatchee River's surface water flow is formed by these major tributaries, as well as groundwater contributions from springs and the Floridan Aquifer (FDEP, 1998).

Because the 303(d) listed segments are contained within the Florida portion of the Choctawhatchee River watershed, this characterization focuses on the Lower Choctawhatchee River cataloging unit (CU 03140203). The Lower Choctawhatchee River cataloging unit contains the portion of the watershed in Florida and a fraction of the portion in Alabama. The Lower Choctawhatchee River cataloging unit is approximately 1,552 mi^2 with 1,420 mi^2 in Florida, as shown in Figure 2-1.

Choctawhatchee River System: Vital Statistics

- *The Choctawhatchee River watershed covers approximately 5,362 mi^2 in Alabama and Florida.*
- *The watershed covers portions of five Florida counties: Holmes, Washington, Jackson, Bay, and Walton.*
- *The Choctawhatchee is Florida's fourth largest river in flow and drainage area. Its average annual discharge is 7,198 cfs.*
- *There have been 13 major floods of the Choctawhatchee River this century. Two occurred in the 1990s.*
- *The watershed is growing rapidly. The human population in the Florida counties increased 41 percent from 1980 to 1995.*
- *The Choctawhatchee River system provides substantial economic and quality of life benefits. Activities supported by the system include fishing, boating, water sports, hunting, camping, and commercial barge shipping. The quality of the system is important for aesthetics, property values, tourism, and public health.*

Source: Adapted from NWFWMD, 1996.

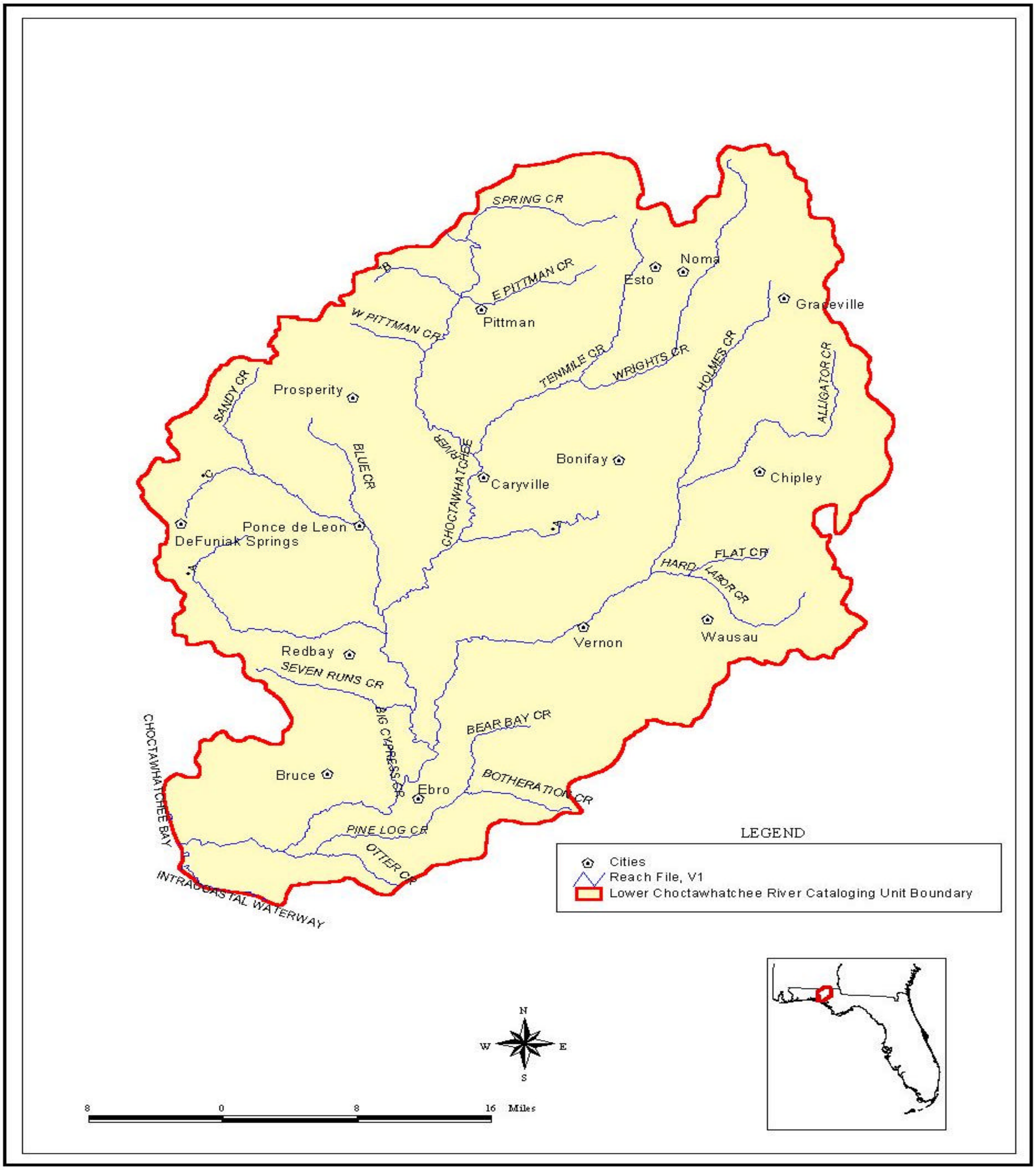

Figure 2-1. The lower Choctawhatchee River cataloging unit

The upper Choctawhatchee flows between steep banks and creates large sandbars, while the lower river flows into a swampy floodplain up to a mile wide. The river is generally characterized as alluvial and tends to carry high sediment loads. In fact, the Choctawhatchee is regarded the “muddiest” of Florida rivers (Nordlie, 1990). The river flows through limestone, and springs contribute considerable amounts of fresh water to the system. Several acidic blackwater creeks also drain into the river and its major tributaries. The basin has all three major river types (i.e., alluvial, spring-fed, and blackwater) as well as several lakes (Hand, Col, and Lord, 1996).

Agriculture and silviculture are the major land uses in the basin. Approximately 87 percent of the Choctawhatchee River basin is forested (USEPA, 1998a). The Northwest Florida Water Management District (NWFWMD), The Nature Conservancy, and Florida Division of Forestry own much of the actual river corridor, and numerous public and private recreation areas and facilities are directly or indirectly associated with the Choctawhatchee River. Tourism continues to be a strong component of the area’s economy. Fishing, hunting, and canoeing have long been mainstays of the region’s tourist economy (NWFWMD, 1996). Scuba diving and hiking are also popular. While the current resident population densities are relatively low, the area is growing quickly.

2.1.1. 303(d)-Listed Segments

The State of Florida identified eight impaired waterbodies in the Choctawhatchee River watershed on its 1998 303(d) list. The three segments addressed in this study are impaired by fecal coliform bacteria. One of these segments is on a tributary stream and two are on the mainstem of the Choctawhatchee River, as presented in Figure 2-2. This subsection briefly summarizes FDEP’s descriptions of these 303(d)-listed coliform-impaired segments (FDEP, 1998).

Choctawhatchee River (downstream segment). Choctawhatchee River map ID 14 basin area extends from Wrights Creek down to Reedy Creek below Caryville. Land use is mainly agriculture, with some silviculture, commerce, industry, strip mine, solid waste disposal, electrical transmission, impoundment, road/highway, and dirt road areas. FDEP (1998) listed the Noma sewage treatment plant (STP) discharge to Wrights Creek; livestock runoff; and urban nonpoint source runoff from Caryville, Westville, and Esto as possible bacteria sources.

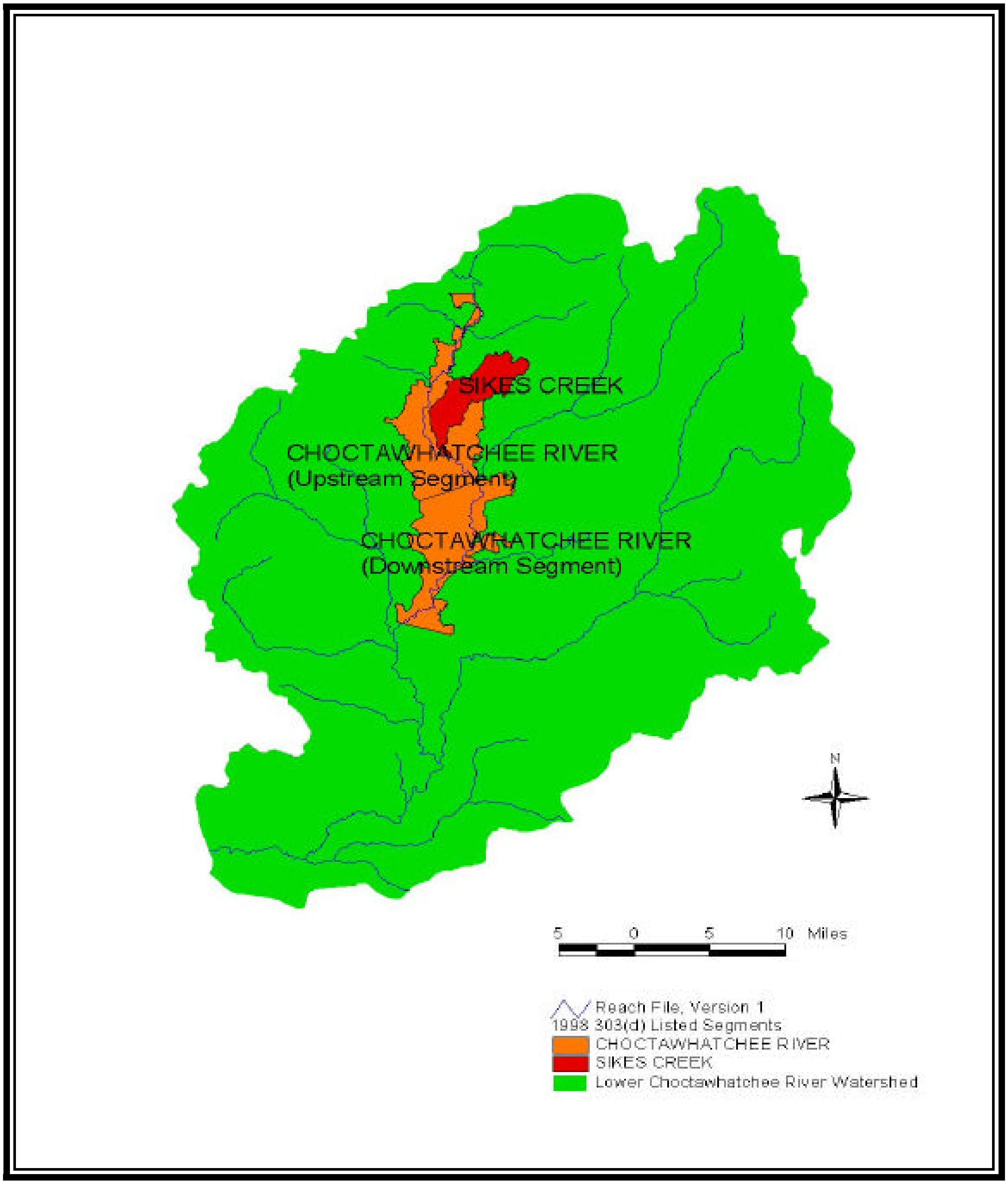

Figure 2-2. 303(d)-listed segments within the Choatwhatchee River watershed

Choctawhatchee River (upstream segment). Choctawhatchee River map ID 24 basin area extends from the Alabama border down to the mouth of Wrights Creek, connecting with Choctawhatchee River map ID 14. Land use in the basin is mostly agriculture and silviculture. Potential sources of bacteria are livestock runoff and possibly Alabama point sources (FDEP, 1998).

Sikes Creek. Sikes Creek is located in Holmes County with its headwaters near Pittman and State Road 2. Major land uses include agriculture, silviculture, residences, impoundment, road/highway, and dirt road areas. Bacteria sources may originate from livestock runoff (FDEP, 1998).

2.1.2. Topography, Geology and Soils

The geology of the Florida panhandle contains uneven platforms of limestone and dolomite rock, covered by thick deposits of organics and clastics (i.e., silt, clay, shell, gravel, and marl) (FDEP, 1998). More specifically, the Choctawhatchee River system bisects the Western Highlands, Marianna Lowlands, New Hope ridge, and Coastal Lowlands physiographic regions.

Topography in the watershed ranges from nearly level to sloping. Frequently, soils are well-drained and sandy in the uplands, and often underlain by loam or clay. Soils in the lowland floodplain may be poorly drained and hydric. Erosion is substantial in portions of the watershed, and the river system discharges a considerable amount of sediment into Choctawhatchee Bay.

Soils within the middle reaches (Holmes County) of the Choctawhatchee River are of the Dothan-Orangeburg-Fuquay association, which is characterized by gentle slopes and thick sandy or loamy layers. Soils in the lower reaches vary from gently sloping and sandy further from the river, to nearly level and loamy and poorly-drained within the floodplain. Poorly-drained soils near streams are often exposed and eroded clay subsoils (NWFWMD, 1996).

Elevations in the Choctawhatchee River basin range from 0 to 358 feet, with a mean elevation of 139 feet.

2.1.3. Climate

Northwest Florida has a mild, subtropical climate. Average annual temperatures tend to be in the upper 60s (degrees Fahrenheit), with mean summer temperatures reaching the low 80s and mean winter temperatures dropping to the low 50s (NWFWMD, 1996).

Prevailing winds are southerly during the spring and summer, and northerly during the fall and winter. Average annual rainfall in northwest Florida is approximately 60 inches (NWFWMD, 1996). Average annual rainfall in the Florida panhandle is 38 inches. There are two peak periods: one from June through August and a second from February through April (FDEP, 1998). Peak rainfall is typically measured in the summer, particularly July. October tends to be the driest month during most years. Table 2-1 summarizes the average monthly and annual rainfall data for the Choctawhatchee area.

Tropical storms and hurricanes can significantly impact the hydrology of northwest Florida. Several storms have made landfall over the Choctawhatchee River watershed during the 1990s. In 1994, for example, tropical storm Alberto dropped over 13 inches of rain in the Choctawhatchee River basin, resulting in the greatest floods on record since 1929 (NWFWMD, 1996). One of the worst storms ever to hit the southeastern United States was hurricane Opal in 1995. The storm dropped large amounts of rainfall on the area.

Table 2-1. Average rainfall at Eden State Gardens near Chocotawhatchee Bay (FDEP, 1998)

Month	1992	1993	1994	Mean
January	5.31	5.35	4.87	5.18
February	10.47	6.88	3.43	6.93
March	2.27	6.24	7.44	5.32
April	1.37	2.52	3.87	2.59
May	1.57	0.82	0.99	1.13
June	5.33	6.86	7.62	6.60
July	8.54	1.25	16.72	8.84
August	13.93	3.17	2.26	6.45
September	3.28	6.01	4.75	4.68
October	1.66	3.40	8.06	4.37
November	9.46	3.08	2.59	5.04
December	3.40	4.90	2.76	3.69
Year Total	**66.59**	**50.48**	**65.36**	**60.62**

2.1.4. Land Use

The major land covers and uses in the Choctawhatchee watershed include forest/silviculture and agriculture. Urban land is estimated to comprise approximately two percent of the watershed in Florida (NWFWMD, 1996). Farming, forestry, and fisheries are more important in the predominantly rural counties of Holmes, Walton, and Washington.

FDEP provided land use coverages from 1995 for the Choctawhatchee River watershed. The nearly 80 land use categories provided by FDEP were grouped into 8 broader categories for TMDL analysis. Table A-1 in Appendix A presents a complete list of the Florida land use categories with the associated TMDL categories.

Since the Florida land use coverage did not cover the portion of the watershed in Alabama, it was necessary to use a different land use coverage for Alabama. A USGS Multiresolution Land Cover (MRLC, 1991-1993) data set was used for the Alabama land uses. The 12 MRLC land uses in the Alabama portion of the watershed were grouped into the eight TMDL categories.

Table 2-2 summarizes the land use distribution in the watershed of each of the three 303(d)-listed segments, using the reclassified landuse categories used in the TMDL analysis. Table A-2 in Appendix A contains a complete list of the land uses and their associated acreage used for this TMDL.

Table 2-2. Land uses in the Sikes Creek and Choctawhatchee River watersheds

Land Use	Choctawhatchee (upstream segment) (acres)	Choctawhatchee (downstream segment) (acres)	Sikes Creek (acres)
Cropland[a]	47,464.91	6,783.84	835.08
Forest/Vegetated	97,896.07	34,334.10	6,614.23
Open Land	229.95	21.13	0.00
Other	2,675.55	303.78	0.22
Pasture[a]	32,354.55	4,687.55	614.22
Residential	4,263.60	1,685.03	109.19
Urban	450.33	709.86	15.57
Wetlands	35,904.37	23,589.25	2,790.96
TOTAL	221,239.33	72,114.54	10979.47

[a]Florida land use classification is "Cropland and Pasture." To separate into "Cropland" and "Pasture," the ratio of cropland and pasture from the 1997 Census of Agriculture for the appropriate counties was applied to the Florida classification.

2.1.5. Hydrology and Channel Morphology

Data in Table 2-3 characterize the channel geometry and flow for the three 303(d)-listed segments in the Choctawhatchee River watershed addressed in this report. Data for the Choctawhatchee River comes from Reach File, Version 1 (RF1). Data for Sikes Creek comes from Reach File, Version 3 (RF3), which provides limited data on stream characteristics. It should be noted that Table 2-3 presents general information for characterization of the entire listed segment. For the TMDL analysis and source response linkage, the listed segments and their tributaries were broken into smaller segments. Identification of stream characteristics for the individual segments is discussed in Section 5.3.2 (Model Setup). Note that for these purposes depth and width are considered constant with flow. Because higher velocity accompanies higher flows, beach and shellfish closures may need to be made more quickly at higher flow events.

Table 2-3. Reach File 1 channel geometry and flow information for the Choctawhatchee River and Sikes Creek watersheds identified on Florida's 303(d) list as impaired by bacteria

Listed segment	Length (mile)	Mean Flow (ft^3/s)	7Q10 (ft^3/s)	Slope	Mean Depth (ft)	Mean Width (ft)
Choctawhatchee River (upstream segment)	22.2	4,817.98	486.99	0.00017	2.51	236.13
Choctawhatchee River (downstream segment)	18.0	5,629.41	921.69	0.000265	3.02	249.89
Sikes Creek[a]	6.33	_[b]	_[b]	.00168	1.82	41.62

[a]Sikes Creek is not contained within the RF1 coverage, therefore the RF3 coverage was used
[b]mean flow and 7Q10 flow are not available on the RF3 database.

2.2 RESOURCE MANAGEMENT ACTIVITIES AND ISSUES

The entire Choctawhatchee River watershed is within two states. It includes portions of 15 counties (six in Florida, 9 in Alabama) and 24 incorporated communities. Management of the system includes the activities of numerous local governments, state and federal agencies, non-government organizations, and the private sector (NWFWMD, 1996).

Local governments and agencies in Florida that have jurisdiction within the Choctawhatchee watershed include Walton County, covering approximately 44 percent of the watershed area within Florida; Washington and Holmes counties, each covering 25 percent of the watershed; and Jackson and Bay counties, covering 4 percent and 2 percent of the watershed, respectively.

Incorporated cities within the Florida portion of the Choctawhatchee watershed include: Bonifay, Esto, Noma, Ponce de Leon, and Westville (Holmes County); Chipley, Caryville, Vernon, Ebro, and Wausau (Washington County); Freeport and DeFuniak Springs (Walton County); and Graceville (Jackson County). Incorporated communities within Bay County occur along the Choctawhatchee Bay and are not within the watershed of the river.

The portion of the watershed in Alabama (approximately 3,112 mi^2) includes 9 counties: Bullock, Pike, Barbour, Dale, Coffee, Covington, Geneva, Henry, and Houston. Incorporated cities include Dothan, Ozark, and Enterprise.

2.2.1. Chapter 62, Florida Administrative Code

Water Quality Standards

Florida's surface water quality standards, as established in Chapter 62-302 of the Florida Administrative Code, vary according to a waterbody's surface water classification. The Choctawhatchee River is a Class III freshwater waterbody designated for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Waterbody classifications are arranged according to the degree of protection required: Class I waters generally have the most stringent water quality criteria and Class V waters generally have the least stringent criteria. Criteria applicable to a classification are designed to maintain the minimum conditions needed to ensure the suitability of water for the designated use of the waterbody.

The Florida state standard for bacteriological quality for fecal coliform bacteria specifies the following:

> The number per 100 mL (Most Probable Number (MPN) or membrane filter (MF)) counts) shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period (Chapter 62-302.530 F.A.C.).

Outstanding Florida Waters Designation

Chapter 62-302.700 of the Florida Administrative Code (F.A.C.) affords special protection to waterbodies designated by the State of Florida as Outstanding Florida Waters (OFW) or Outstanding National Resource Waters (ONRW). Under this designation no degradation of water quality, other than that allowed in Rule 62-4.242(2) and (3), F.A.C., is permitted. The Choctawhatchee River is afforded special protection under Chapter 62-302.700 because of its designation as a Special Water by FDEP.

2.2.2. State Resource Management Agencies

Florida Department of Environmental Protection

The FDEP is Florida's principal environmental and natural resources management agency. It is responsible for regulating air, water, wastewater, storm water, and hazardous waste pollution through a permitting and certification process (FDEP, 1998). FDEP implements the OFW program, enforces water quality standards, and administers aquatic preserves. Its mission is to protect, conserve, and manage Florida's environment and natural resources. FDEP accomplishes its mission in a manner that

- Provides stewardship of Florida's ecosystems so that the state's unique quality of life may be preserved for present and future generations.
- Protects the public health and safety.
- Provides for the responsible and wise use of the state's mineral, cultural and living resources.
- Provides efficient and equitable service to the public.
- Provides consistent and impartial implementation of the law.

FDEP’s Northwest District office, located in Pensacola, facilitates management of the Choctawhatchee River and Bay system.

In 1993, the FDEP initiated a process to develop an ecosystem management strategy for the state, resulting in the *Ecosystem Management Implementation Strategy* (EMIS) published in October 1995. The EMIS document set forth fundamental site-specific strategies, which required identifying major watershed basins called Ecosystem Management Areas (EMAs). The Choctawhatchee EMA is one of six designated by the FDEP Northwest District. EMAs are delineated by watershed. The boundaries of the Choctawhatchee EMA are consistent with the Choctawhatchee River Surface Water Improvement and Management (SWIM) planning area with comparable objectives towards watershed management.

Northwest Florida Water Management District

Since its establishment in 1972, the NWFWMD has been involved in efforts to understand and appropriately manage northwest Florida’s water resources (NWFWMD, 1996). The NWFWMD has acquired over 51,189 acres along the Choctawhatchee River and its tributaries through the Save Our Rivers and Preservation 2000 programs. This equates to approximately 87 percent of Florida’s portion of the floodplain. These lands are managed to facilitate the conservation and restoration of their natural, aesthetic, hydrologic, and recreational values (NWFWMD, 1996). Their public status precludes intensive development.

Choctawhatchee River and Bay Surface Water Improvement and Management (SWIM) Plan. In Chapter 373, Florida Statutes, the Florida Legislature determined that the water quality in many of the state’s waterbodies is either degraded or in danger of degradation. Where associated systems have suffered as a result of degraded water quality, so have aesthetics, recreation, wildlife habitat, drinking water, and associated economic resources. Causes of degradation include point and nonpoint source pollution and destruction of natural systems that enhance water quality and provide habitat. In response to the identified problems, the Florida Legislature directed the state's five water management districts to develop and implement plans to improve water quality and related aspects of the State's surface waters. SWIM plans describe the physical and biological character of an identified basin, issues surrounding management of the basin, and projects designed to address identified issues (NWFWMD, 1996).

After identifying the Choctawhatchee system as a SWIM priority waterbody, in December 1996, the NWFWMD completed a plan for its protection and restoration. The plan is intended to:

- characterize the Choctawhatchee River and Bay system;
- describe ongoing resource management activities;
- identify major problems affecting the system; and
- propose a strategy and set of projects that, if implemented, will facilitate the long-term restoration and protection of the system.

Save Our Rivers program. Section 373.59 Florida Statutes created funds that allow water management districts to acquire lands for water management, water supply, and conservation or protection of water resources.

Florida Department of Agriculture and Consumer Services

The Florida Department of Agriculture and Consumer Services (DACS) is responsible for regulating the purchase and use of restricted pesticides and assists the Natural Resources Conservation Service (NRCS) with soil and water conservation. The DACS Division of Forestry administers approximately 355 acres of bottomland forest along Holmes Creek and the Choctawhatchee River (Choctawhatchee River State Forest).

Florida Fish and Wildlife Conservation Commission

The Florida Fish and Wildlife Conservation Commission (FFWCC) has regulatory and management jurisdiction over game and nongame wildlife and freshwater aquatic life throughout the Choctawhatchee River watershed (NWFWMD, 1996).

Alabama State Agencies

Alabama agencies that are responsible for managing the Choctawhatchee River watershed include the Alabama Department of Environmental Management (DEM), the Department of Conservation and Natural Resources, the Game and Fish Division of the Department of Conservation and Natural Resources, and the Choctawhatchee and Pea Rivers Watershed Management Authority.

2.2.3 Federal Resource Management Agencies

Federal laws relevant to the Choctawhatchee basin include the National Flood Insurance Act of 1968, the Clean Water Act of 1977 (amended 1987), the National Environmental Policy Act of 1969, and Endangered Species Act of 1973, as amended. Federal agencies responsible for implementing these laws include the U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), National Oceanic and Atmospheric Administration (NOAA), U.S. Air Force, U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency (USEPA).

Approximately 242,243 acres (378 mi^2) of the Choctawhatchee watershed are within the Eglin Air Force Base Reservation. At 464,000 acres, this base is one of the world's largest military installations (NWFWMD, 1996).

3.0. INVENTORY OF WATERSHED INFORMATION

This section presents an overview of the instream water quality monitoring data and flow data available for waterbodies in the Choctawhatchee River watershed. The purpose is to inventory available data that are appropriate to use in characterizing the problem and developing fecal coliform TMDLs for the three impaired segments. The water quality data related to fecal coliform bacteria for the Choctawhatchee River watershed and presented in this section were collected from USEPA's STORET database.

3.1 EXISTING MONITORING AND FIELD ASSESSMENT DATA

3.1.1 Water Quality Data

A number of state and federal agencies monitor water quality within the Choctawhatchee River watershed in Florida. The FDEP, FDEP Northwest District office, the NWFWMD, USGS, U.S. Fish and Wildlife Survey (USFWS), and the USEPA are currently monitoring for fecal coliform. Note that the various units given for fecal coliforms are equivalent. These are given alternately as cfu/100 ml or as counts (#/100 mL).

The *Northwest Florida District Water Quality Assessment, 1996 305(b) Technical Appendix* describes the overall water quality in the Choctawhatchee River as good, although some of the tributaries received water quality ratings of fair to poor. The worst water quality detected by the NWFWMD was at the Alabama-Florida border during water quality sampling conducted in the mid-to-late 1980s. In 1989, 27 permitted domestic waste facilities and 10 permitted industrial facilities discharged into the river system in Alabama (NWFWMD, 1996). There are no permitted Combined Sewer Outfalls (CSOs) in Florida.

A comprehensive data search for the Choctawhatchee River watershed in Florida was conducted in the STORET database, which includes data from USGS, EPA Region IV, FDEP, U.S. Forest Service, and NWFWMD databases. There are 88 existing or past monitoring stations within the Choctawhatchee River watershed in Florida that have at least one observation of fecal coliform reported in STORET. Only data from stations with a minimum of five data points for fecal coliform since 1980 were used to evaluate water quality conditions in the entire watershed. Using this criterion, data from 32 of the 88 monitoring stations were used to assess current water quality conditions. Seven of the 32 stations are located in subwatersheds contributing to the three 303(d)-listed segments. Table 3-1 summarizes the water quality data collected at these seven stations. The data include minimum, maximum, and median values of fecal coliform counts, as well as the number of violations of the applicable water quality criteria (i.e., instantaneous maximum of 800 cfu/100 mL for fecal coliform). Four of these seven stations are actually on the listed segments. The locations of the water quality monitoring stations within the Choctawhatchee River watershed are presented in Figure 3-1.

In order to evaluate fecal coliform coming into the Choctawhatchee River in Florida from Alabama, monitoring stations in Alabama that are closest to the state line were chosen: Pea River01, Double Bridges Creek, Sandy Branch, Claybank

Creek01, and Hurricane Creek01 and 02. Fecal coliform was measured at each of these stations; however, no violations of Alabama's water quality standard were indicated. Data indicate that other stream segments further north in the watershed may have bacteria problems. Blanket Creek01 had two violations in four samples, using Florida's standard as the threshold, with a maximum concentration of 2,500/100 mL and a median concentration of 766/100 mL. The Unnamed Tributary01 to Harrand Creek had 3 violations in four samples with a maximum concentration of 15,000/100 mL, a median concentration of 4,000/100 mL, and a minimum concentration of 688/100 mL. Walnut Creek01 had one violation in five samples, with a maximum concentration of 1,040/100 mL and a median concentration of 57/100 mL. The actual data used for the evaluation of the water quality in the Florida portion of the Choctawhatchee watershed are presented in Appendix B.

Table 3-1. Summary of available water quality data in the Choctawhatchee watershed at monitoring stations with at least five samples collected from 1980 to 1998

Station	Location	Start Date	End Date	No. of Samples	Min	Median	Max	Violations of WQS	Percent Violating [a]
32020011	Choctawhatchee Riv Hwy 90	3/2/82	5/13/97	25	20	100	1,400	3	12
32020001	Choctawhatchee River At Hwy 2	6/3/90	5/13/97	23	10	150	4,100	3	13
32020002	Wrights Cr Hwy	12/4/86	5/13/97	26	10	145	1,200	3	12
305057085513801	Sikes Cr. @ C.R. 179	12/9/92	8/23/94	6	40	161	300	0	0
305127085454501	Wrights Creek @ Hwy 177A	4/22/92	10/16/95	11	58	116	360	0	0
305531085405301	Tenmile Cr. ab Wrights Cr.	1/16/92	10/20/92	5	1	64	800	0	0
305700085503301	Choctaw. Riv. ab W. Pittman	1/16/92	8/15/95	13	1	65	2200	2	15

[a] Number of instances violating the instantaneous standard of 800/100 mL on any given day. (Sufficient data were not available to compare to the geometric mean standard of 200/100 mL.)
The shaded rows indicate stations that are on 303(d)-listed segments

3.1.2 Flow Data

Choctawhatchee River Watershed in Florida

There are 11 USGS flow gaging stations within the Lower Choctawhatchee cataloging unit in Florida. Table 3-2 inventories these gages. Two of these stations are located on 303(d)-listed segments within the watershed. The table also lists the period of record of available continuous daily flow data. Figure 3-1 presents the USGS gage stations located in the Choctawhatchee River watershed.

No flow data were collected concurrent with most of the fecal coliform data that were collected throughout the subwatersheds of the Choctawhatchee River in Florida.

Table 3-2. USGS flow gages within the Lower Choctawhatchee River watershed

Station No.	Station Name	County	Period of Record[a]
02365200[b]	Choctawhatchee River near Pittman, FL	Holmes	7/1/76-9/30/81
02365237	Fowler Branch near Leonia, FL	Holmes	n/a[c]
02365435	Wrights Creek near Bonifay, FL	Holmes	n/a[c]
02365470	Wrights Creek at 177-A near Bonifay, FL	Holmes	n/a[c]
02365500[b]	Choctawhatchee River at Caryville, FL	Holmes	10/1/29-3/31/95; 10/1/96-9/30/97
02365700	Sandy Creek at Ponce De Leon, FL	Holmes	n/a[c]
02366000	Holmes Creek at Vernon, FL	Washington	n/a[c]
02366164	Reedy Branch at New Hope, FL	Washington	n/a[c]
02366500	Choctawhatchee River near Bruce, FL	Walton	10/1/30-3/31/83; 6/1/84-9/30/97
02366859	Pate Branch near Freeport, FL	Walton	n/a[c]
02365310	Grants Branch Tributary near Fadette, AL	Geneva	n/a[c]

[a] Period of record for daily flow data. Does not include peak flow data.

[b] Located on 303(d)-listed segment

[c] Only peak flow data is available for this station.

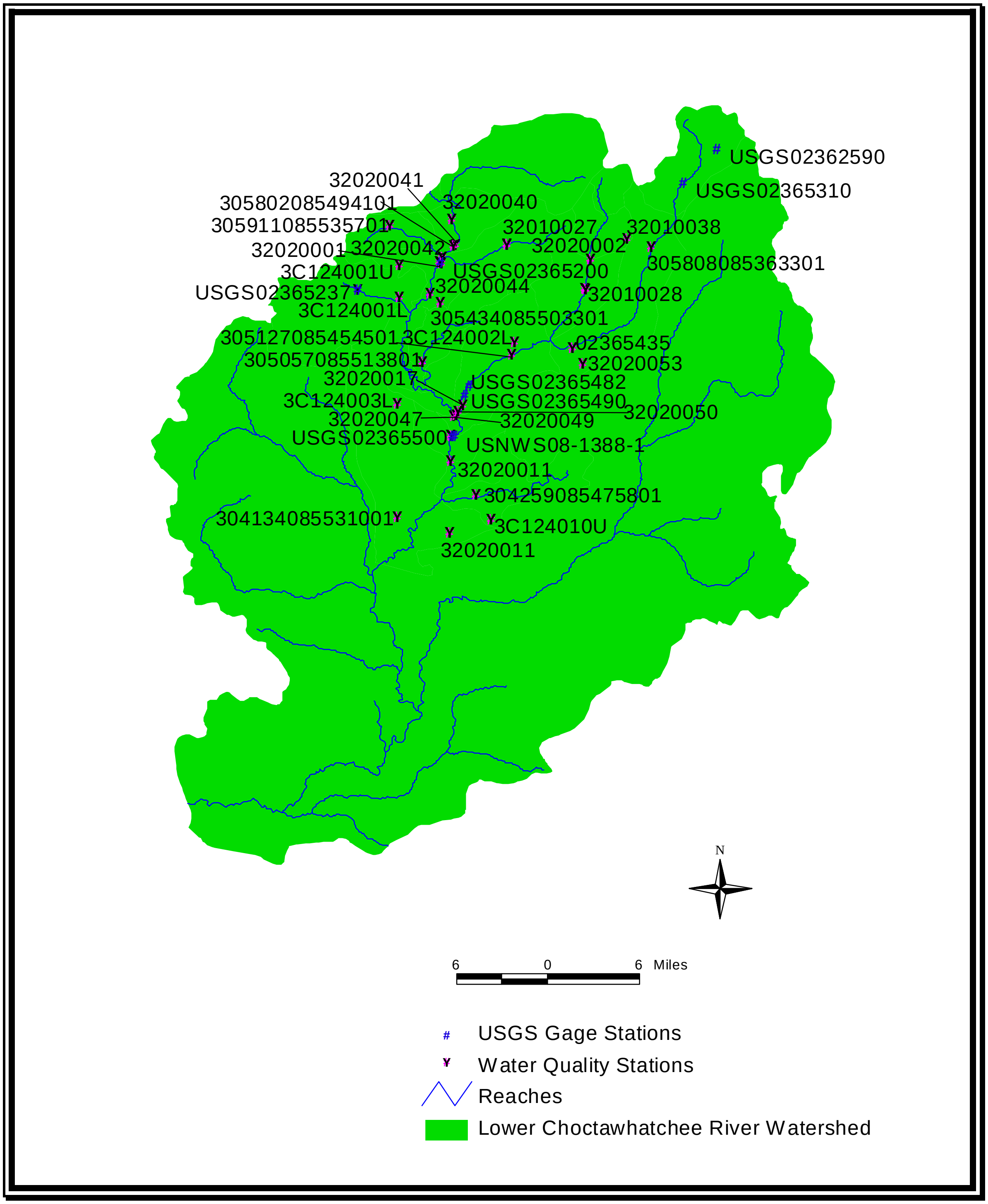

Figure 3-1. Water qulaity monitoring stations with at least 5 fecal coliform data points from 1980 to 1998 and USGS gage stations in the Choctawhatchee River watershed

4.0 SOURCE ASSESSMENT

Sources of fecal coliform bacteria are numerous and often occur in combination. Potential point sources include poorly treated municipal sewage, urban stormwater runoff, sanitary sewer overflows, combined sewer overflows (CSOs), and untreated domestic sewage. Potential nonpoint sources include manure disposal and runoff of animal waste from feedlots, disposal and handling of poultry litter, failing or ill-sited septic systems, runoff from pasture lands, application of manure or municipal sludge to cropland and other agricultural areas, and loadings from various wildlife species.

4.1 ASSESSMENT OF POINT SOURCES

The greatest potential source of human fecal coliform from point sources is raw sewage. Raw sewage typically has a fecal coliform count of 10^6 to 10^8/100mL (Metcalf & Eddy, 1991), along with significant concentrations of viruses, protozoans, and other parasites. Raw sewage, while usually not discharged intentionally, may reach waterbodies through leaks in sanitary sewer systems, overflows from surcharged sanitary sewers (non-combined sewer), illicit connections of sanitary sewers to storm sewer collection systems, or unidentified broken sanitary sewer lines.

USEPA's permit compliance system (PCS) files and other sources were queried to identify and characterize any point sources discharging fecal coliform bacteria within the watersheds of listed segments in the Florida portion of the Choctawhatchee River watershed. Only major facilities (flow-rate greater than 1.0 cfs) were considered to contribute significant amounts of fecal coliform to the 303(d)-listed segments in this study. Based on this criteria, no facilities were identified as present in any of the Florida watersheds contributing to the 303(d)-listed segments. The discharging facilities in Alabama, listed in Table 4.1, were identified as major point sources and considered in the TMDL analysis. The maximum permitted fecal coliform discharge concentration of 200 counts/100 mL was assumed for these point sources.

Table 4.1 Major PCS facilities in the Alabama portion of the Choctawhatchee River watershed

Facility	NPDES No.	Permit Flow Limit (mgd)	Receiving Water
Union Springs Utilites Board	AL 0060445	1.5	Bluff Creek
Tray City of Walnut Creek WWTP	AL 0032310	5.2	Walnut Creek
Enterprise Northeast Lagoon	AL 0020061	1.1	Tributary
Enterprise Southeast Lagoon	AL 0020044	1.1	Cowpen Creek
Ozark City of Southside WWT	AL 0056324	2.1	Hurricane Creek

Enterprise WWTP 2 College St.	AL 0020036	1.5	Blanket Creek
Dothan City of Choctawhatchee	AL 0047465	5.0	Little Choctawhatchee River
Dothan City of Beaver Creek	AL 0022756	6.0	Beaver Creek
Geneva WWSB Sewage Treatment Plant	AL 0020273	1.215	Pea River

4.2 ASSESSMENT OF NONPOINT SOURCES

Nonpoint sources of fecal coliform bacteria are typically separated into urban and rural components. Urban settings are typically characterized by larger areas of paved impervious surfaces. Important sources of bacteria loads in urban areas are storm runoff from impervious areas, failing septic tanks, and leaking sanitary sewer systems. In rural settings, the amount of impervious area is usually much lower, resulting in greater infiltration of precipitation and less runoff. Sources of fecal coliform in rural areas may include runoff from fields receiving land application of animal wastes, runoff from concentrated animal operations, contributions from wildlife, cattle in the stream, and failing septic tanks (IFAS, 1998).

The Choctawhatchee River watershed was evaluated to identify and quantify sources of bacteria within the watersheds of the listed segments. The identified nonpoint sources of fecal coliform bacteria within the watersheds of the listed segments include

- Runoff from pasturelands with grazing livestock
- Runoff from cropland
- Failing septic systems
- Wildlife contributions
- Cattle in streams

Other sources include runoff from residential and urban areas.

Potential sources of nonpoint pollution in the Choctawhatchee watershed include failing septic systems, runoff from pasture lands, runoff from cropland, and wildlife and cattle secretion in stream reaches. Septic systems are common in unincorporated portions of the watershed and may be direct or indirect sources of bacterial pollution via ground and surface waters. A high percentage of the citizens in Freeport, Santa Rosa Beach, Hogtown, and LaGrange Bayous rely on septic systems for wastewater treatment (FDEP, 1998). Although specific information regarding agricultural management practices and activities are not readily available, agricultural census data can be used to evaluate the loading from the lands. Wildlife data were available from the Florida Fish and Wildlife Conservation Commission.

For the purpose of source assessment and ultimately modeling, the state of Florida's subwatershed coverage was used. This coverage provided a basis for subdividing the Choctawhatchee River watershed into smaller hydrologic units. Figure 4-1 presents the subwatersheds for each of the 303(d)-listed segments evaluated in this study for the Choctawhatchee River watershed.

The following sections provide information on the characterization and quantification of bacteria sources within each listed watershed.

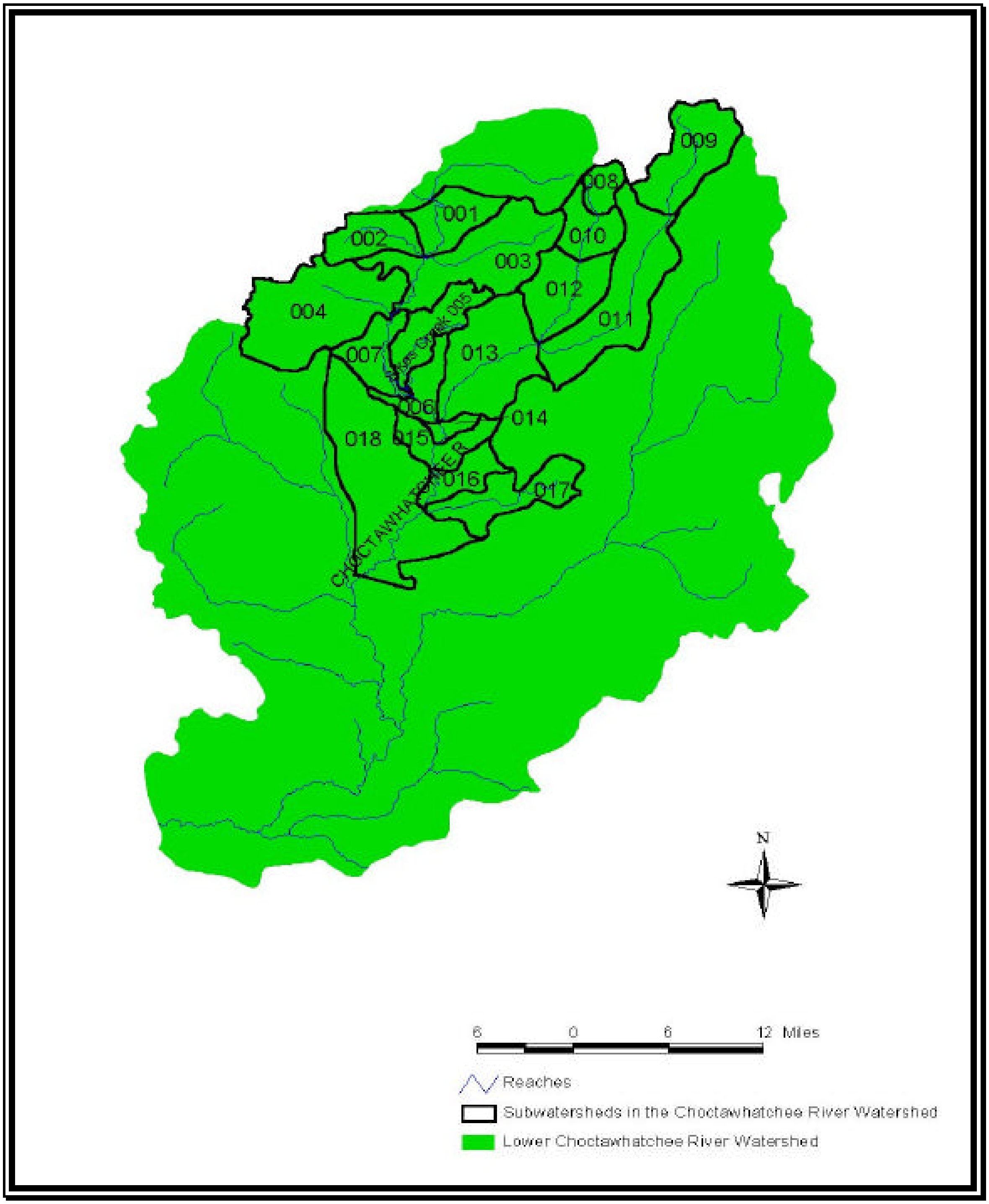

Figure 4-1. Subwatersheds within the Choctawhatchee River watershed

4.2.1 Grazing Livestock

Grazing cattle and other agricultural animals deposit manure and, therefore, fecal coliform on the land surface, where it is available for washoff and delivery to receiving waterbodies. Grazing animals in the watersheds of the Choctawhatchee River contribute fecal coliform to pasture land. Data from the 1997 Census of Agriculture provided numbers of livestock in each county covering portions of the watersheds, as well as total pastureland within each county. The livestock counts and pasture areas were used to determine livestock densities (e.g., number of cows per acres of pastureland) for each county, assuming livestock are evenly distributed over pasture area in the county. Grazing livestock numbers were not explicitly calculated for the Alabama portion of the Choctawhatchee watershed, although their contribution was represented in more general terms though the source - response linkage.

The area of pastureland in each subwatershed was determined using GIS data layers. The pasture area of the subwatershed and the livestock density for the counties were used to calculate the livestock counts within the subwatershed. The watershed of Sikes Creek is contained within a single county; however, the upper segment of the Choctawhatchee River is contained within two counties—Holmes and Geneva, and the watershed of the lower segment of the Choctawhatchee River is in three counties—Holmes, Walton, and Washington. If pasture land in a subwatershed covered more than one county, the livestock density for each particular county was applied to the area of the subwatershed located within that county. The densities for each section were then summed to give livestock densities for the entire subwatershed.

For example, the Choctawhatchee 18 subwatershed in the lower Choctawhatchee watershed contains 3300 acres of pasture land that crosses Holmes, Walton, and Washington counties. There are 2539 acres of pasture land in Holmes County, 430 acres in Walton County, and 329 acres in Washington County. In Holmes County the density of cattle is approximately 0.570 cows/acre, 0.450 cows/acre in Walton County, and 0.618 cows/acre in Washington County. Therefore, there are an estimated 1,447 cattle in Holmes County, 194 cattle in Walton County, and 204 cattle in Washington County. This is a grand total of 1845 heads of cattle in the Choctawhatchee 18 subwatershed.

$$\left(.570\ \frac{cows}{acre} \times 2539.9\ acres\right) + \left(.450\ \frac{cows}{acre} \times 430.95\ acres\right) + \left(.618\ \frac{cows}{acre} \times 329.85\ acres\right) = 1845\ cows$$

The subwatershed livestock counts for the major listed watersheds are presented in the following sections.

Sikes Creek

Table 4-2 presents the livestock counts for each subwatershed within the Sikes Creek watershed.

Table 4-2. Livestock counts for subwatersheds within the Sikes Creek watershed

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs	Hogs
005	Sikes 5	614	350	169	25	3	14

Choctawhatchee River (Upstream Segment)

Table 4-3 presents the livestock counts for each subwatershed within the Choctawhatchee River watershed (upstream segment).

Table 4-3. Livestock counts for subwatersheds within the Choctawhatchee River watershed (upstream segment)

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs	Hogs
001	Choctawhatchee 1	1020	598	299	33	3	32
002	Choctawhatchee 2	1457	834	406	58	6	35
003	Choctawhatchee 3	3874	2210	1070	158	17	90
004	Choctawhatchee 4	3107	1770	855	128	14	70
006	Choctawhatchee 6	276	158	76	11	1	6
007	Choctawhatchee 7	686	391	189	28	3	15
008	Choctawhatchee 8	943	574	300	18	1	42
009	Choctawhatchee 9	4337	2640	1382	82	4	192
010	Choctawhatchee	1063	622	310	35	3	33
011	Choctawhatchee	4984	2864	1399	192	21	126
012	Choctawhatchee	2051	1168	564	85	9	46
013	Choctawhatchee	2123	1210	584	88	10	48
TOTAL		25927	15039	7434	916	92	735

Choctawhatchee River (Downstream Segment)

Table 4-4 presents the livestock counts for each subwatershed within the Choctawhatchee River watershed (downstream segment).

Table 4-4. Livestock counts for subwatersheds within the Choctawhatchee River watershed (downstream segment)

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs	Hogs
014	Choctawhatchee14	47	28	14	2	0	1
015	Choctawhatchee15	274	163	81	12	2	6
016	Choctawhatchee16	215	133	67	9	1	5
017	Choctawhatchee17	849	521	263	36	4	19

ID	Subwatershed	Pasture (acres)	Cattle/Calves	Beef Cows	Milk Cows	Sheep/Lambs	Hogs
018	Choctawhatchee18	3300	1845	886	120	15	67
	TOTAL	4687	2690	1311	179	22	98

4.2.2 Failing Septic Systems

Onsite septic systems have the potential to deliver bacteria loads to surface waters due to system failure and malfunction. NSFC (1993) provided estimates of failing septic systems for each county within the Choctawhatchee River watershed. The number of failing systems in each subwatershed was then estimated based on subwatershed area and density of failing systems in each county. Without knowing the spatial distribution of septic systems, functioning or failing, it was assumed that failing systems are distributed evenly throughout their corresponding counties. A density of failing septic systems (number per acre) was determined for each county by dividing the number of failing systems by the county area. The densities were then applied to the area of the subwatershed to determine the number of failing systems in the subwatershed. In cases where the subwatershed is not contained within a single county (e.g., Choctawhatchee 18 subwatershed), the number of failing systems was determined for each area of the subwatershed located in the respective counties. The number of failing systems within each area was then summed to get the total number of failing septic systems in the subwatershed. [It should be noted that there was no information on failing septic counts for Washington County in NFSC (1993). The average of the surrounding county densities was used to estimate the number of failing septic systems in areas within Washington County.] The septic failure rates for Holmes, Geneva, Washington, and Walton counties are 1.12 percent, 0.41 percent, 0.76 percent, and 0.09 percent, respectively.

The following sections present the estimates of the number of failing septic systems in the subwatersheds within each listed watershed.

Sikes Creek

Table 4-5 presents the number of failing septic systems for each subwatershed within the Sikes Creek watershed.

Table 4-5. Inventory of failing septic systems in the subwatersheds of the Sikes Creek watershed

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
005	Sikes 5	11,037	2.12

Choctawhatchee River (Upstream Segment)

Table 4-6 presents the number of failing septic systems for each subwatershed within the Choctawhatchee River watershed (upstream segment).

Table 4-6. Inventory of failing septic systems in the subwatersheds of the Choctawhatchee River watershed (upstream segment)

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
001	Upper Choctawhatchee 1	7,416	1.13
002	Upper Choctawhatchee 2	9,819	1.83
003	Upper Choctawhatchee 3	26,949	5.03
004	Upper Choctawhatchee 4	32,225	6.2
006	Upper Choctawhatchee 6	6,965	1.34
007	Upper Choctawhatchee 7	9,070	1.74
008	Upper Choctawhatchee 8	4,477	0.30
009	Upper Choctawhatchee 9	17,868	1.18
010	Upper Choctawhatchee 10	8,033	1.40
011	Upper Choctawhatchee 11	28,187	5.24
012	Upper Choctawhatchee 12	15,146	2.91
013	Upper Choctawhatchee 13	24,862	4.78
TOTAL		191,022	33.08

Choctawhatchee River (Downstream Segment)

Table 4-7 presents the number of failing septic systems for each subwatershed within the Choctawhatchee River watershed (downstream segment).

Table 4-7. Inventory of failing septic systems in the subwatersheds of the Choctawhatchee River watershed(downstream segment)

ID	Subwatershed	Subwatershed Area (acres)	Failing Septic Systems
014	Lower Choctawhatchee 14	2,300	0.38
015	Lower Choctawhatchee 15	7,951	1.24
016	Lower Choctawhatchee 16	6,959	0.82
017	Lower Choctawhatchee 17	14,111	1.62
018	Lower Choctawhatchee 18	42,362	6.26
TOTAL		73,685	10.32

The fecal coliform loading rates for failing septic systems used in developing TMDLs for the Choctawhatchee River watershed are presented in Table C-1 in Appendix C.

4.2.3 Wildlife

Wildlife is another potential source of fecal coliform loading to receiving waterbodies. For this TMDL, the deer population is assumed to represent the wildlife contribution. It is also assumed that deer habitat within the watershed includes Forest/Vegetated, Cropland, Wetlands, Open Land, and Pasture land uses. Typical estimates for distributions of deer within the region were provided by the Florida Fish and Wildlife Conservation Commission (personal communication, August 27, 1999). Three different densities (deer per square mile) were available for the region, representing different management areas. Estimates are determined based on "track estimates" where the ground is cleared, and then animal tracks are counted to estimate populations within an area. The provided densities were applied to deer habitat areas within the watershed to estimate population counts by subwatershed. The highest density (6 deer/mi^2) was applied to the Forest/Vegetated, Cropland, and Wetlands areas, and the lower density (3 deer/mi^2) was applied to Open Land and Pasture areas. The following sections present the inventories of deer in each subwatershed by land use considered deer habitat.

Sikes Creek

Table 4-8 presents the wildlife counts by land use for each subwatershed within the Sikes Creek watershed.

Table 4-8. Wildlife counts for each subwatershed within the Sikes Creek watershed

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
005	Sikes 5	8	60	0	3	25	96

Choctawhatchee River (Upstream Segment)

Table 4-9 presents the wildlife counts by land use for each subwatershed within the Choctawhatchee River watershed (upstream segment).

Table 4-9. Wildlife counts for each subwatershed within the Choctawhatchee River watershed (upstream segment)

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
001	Choctawhatchee 1	16	28	0	5	9	58
002	Choctawhatchee 2	18	45	0	7	8	78
003	Choctawhatchee 3	52	103	0	19	39	213

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
004	Choctawhatchee 4	38	178	0	16	34	266
006	Choctawhatchee 6	3	33	0	1	21	58
007	Choctawhatchee 7	8	35	0	3	25	71
008	Choctawhatchee 8	13	10	0	5	7	35
009	Choctawhatchee 9	55	42	0	22	18	137
010	Choctawhatchee 10	12	34	0	5	12	63
011	Choctawhatchee 11	59	94	0	25	43	221
012	Choctawhatchee 12	25	57	0	10	29	121
013	Choctawhatchee 13	26	124	0	11	46	207
TOTAL		325	783	0	129	291	1528

Choctawhatchee River (Downstream Segment)

Table 4-10 presents the wildlife counts by land use for each subwatershed within the Choctawhatchee River watershed (downstream segment).

Table 4-10. Wildlife counts for each subwatershed within the Choctawhatchee River watershed (downstream segment)

ID	Subwatershed	Cropland	Forest/Veg.	Open Land	Pasture	Wetlands	Total
014	Choctawhatchee 14	1	11	0	0	7	19
015	Choctawhatchee 15	4	36	0	1	23	64
016	Choctawhatchee 16	3	28	0	1	25	57
017	Choctawhatchee 17	12	66	0	4	34	116
018	Choctawhatchee 18	41	168	0	17	124	350
TOTAL		61	309	0	23	213	606

4.2.4. Cattle in the Stream

When cattle are not denied access to stream reaches, they represent a major potential source of direct fecal coliform loading to the stream. To account for the potential influence of cattle loads deposited directly in stream reaches within the watersheds, fecal coliform loads from cattle in streams were calculated and characterized as a direct source of loading to the stream segments. To determine the number of cows in the stream at any time, it was assumed that 10 percent of the cows in the watershed have access to streams; that 7 percent of those cows are in or around the stream at any given time; and that 5 percent of those cows in the stream are actually depositing manure in the stream reach at any given time. The fecal coliform loading rates from cattle in the stream used in developing TMDLs for the Choctawhatchee River watershed are presented in Table C-2 in Appendix C.

4.2.5 Critical Conditions

While selecting a numeric endpoint, TMDL developers must also select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a “critical condition.” The critical condition is the set of environmental conditions which, if controls are designed to protect, will ensure attainment of objectives for all other conditions.

Critical conditions for waters impacted by nonpoint sources generally occur during wet weather when storm events cause surface runoff to carry pollutants to waterbodies. Therefore, the selected condition may be a rainfall event with a particular intensity and duration that reoccurs at a specific frequency. Critical conditions for systems mainly impacted by point sources and failing septics generally occur during low flow (i.e., low dilution) conditions when little or no land-based runoff is occurring. For example, the critical condition for controlling a continuous point discharge may be drought stream flow. Pollution controls designed to meet water quality standards for drought flow will ensure compliance of point source dischargers with standards for all flows greater than drought.

Because the majority of available water quality monitoring data for the Choctawhatchee River watershed do not have corresponding flow measurements, it is difficult to fully evaluate critical flow conditions. Without corresponding flow values, it is difficult to determine whether elevated bacteria levels occur during base flow or during high flow.

The only available flow data corresponding to measured coliform values is from the USGS gage 02366500, which is on the Choctawhatchee River near Bruce, Florida. This station is not located on one of the listed segments and may be subject to estuarine influences, but may represent general hydrologic and loading conditions of the upstream listed segments. Unfortunately, the data do not clearly indicate a relationship between flow and instream fecal coliform levels. As presented in Figure 4-2, there appears to be a relationship with higher flows corresponding to higher fecal coliform levels, but this relationship is not consistent.

Another consideration when evaluating critical conditions is seasonality. Samples are collected quarterly at several of the monitoring stations in the watershed, thus providing fecal coliform samples during different times of the year. These data do not suggest any seasonal pattern of instream coliform levels. Available data do not, however, provide consistent records of coliform levels during and across seasons. Nor do they have corresponding flow values. Seasonal differences in coliform levels could be caused by seasonal variations in precipitation and climate or by seasonal differences in activities in the watershed (e.g., land application of waste, recreational activities, etc.). Without flow values or multiple water quality samples, it is difficult to evaluate the existence of or causes for seasonal variation.

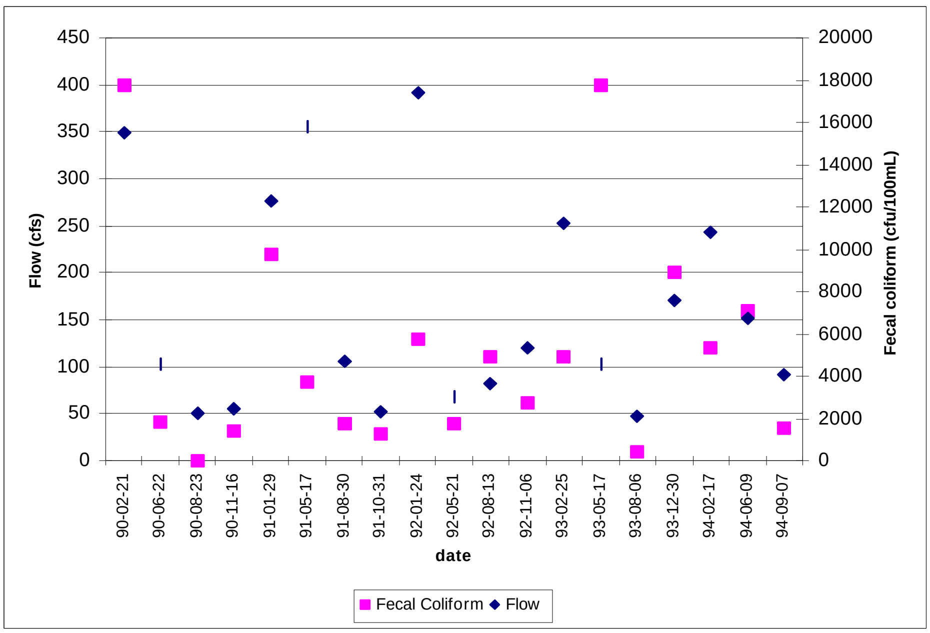

Figure 4-2. Flow and fecal coliform values at USGS gage 02366500 (1990-1994)

5.0 LINKAGE OF SOURCES AND WATER QUALITY RESPONSE

5.1 SELECTED WATERSHEDS

There are eight segments on the mainstem of or tributaries to the Choctawhatchee River that are listed on Florida's 1998 303(d) list as impaired by fecal coliform. Three of these segments are considered for TMDL development in this study. This section presents the technical approach for developing the source and response linkage for the following impaired waters within the Choctawhatchee River watershed

- Sikes Creek
- Choctawhatchee River (upstream segment)
- Choctawhatchee River (downstream segment)

5.2 TMDL ENDPOINT

Because the water quality standards that apply to the Choctawhatchee River and its tributaries have numeric criteria for fecal coliform, those numeric criteria can be used to represent the instream water quality target for the TMDLs. The coliform TMDLs within the Choctawhatchee River watershed will establish wasteload and load allocations that are designed to attain the applicable fecal coliform bacteria water quality standards of a monthly average of 200 counts/100 mL, expressed as a geometric mean based on a minimum of 10 samples taken over a 30-day period. The model output provides continuous daily concentrations to compare to this endpoint. To provide a margin of safety (Section 6.2), the TMDL water quality target was set at a geometric mean of 190 counts/100 mL, 5 percent lower than the standard of 200 counts/100 mL.

5.3 LINKAGE OF SOURCES AND TMDL ENDPOINT

Establishing a relationship between the instream water quality target and source loadings is a critical component of TMDL development. It allows for the evaluation of management options that will achieve the desired source load reductions. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses to flow and loading conditions.

Fecal coliform TMDLs for Sikes Creek, the Choctawhatchee River (upstream segment), and the Choctawhatchee River (downstream segment) were determined using watershed/water quality modeling. The following sections discuss the modeling techniques and applications used to establish the TMDLs for the three 303(d)-listed segments.

5.3.1 Modeling Framework

USEPA's Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) system Version 2.0 (USEPA, 1998b) and the Nonpoint Source Model (NPSM) were used to predict the significance of coliform sources and levels in the Choctawhatchee River watershed. BASINS is a multipurpose environmental analysis system for use in performing watershed and water quality-based studies. A geographic information system (GIS) provides the integrating framework for BASINS and allows for the display and analysis of a wide variety of landscape information (e.g., land uses, monitoring stations, point source dischargers). The NPSM simulates nonpoint source runoff from selected watersheds, as well as the transport and flow of pollutants through stream reaches. It produces time series data, allowing for sufficient data to compare to the water quality target in the analysis. Another key reason for using BASINS and the NPSM as the modeling framework is their ability to integrate both point and nonpoint source simulation, as well as to assess instream water quality response.

5.3.2 Model Setup

The watersheds representing the 303(d)-listed segments and contributing waterbodies were divided into 18 subwatersheds (based on the Florida subwatershed coverage) to spatially evaluate pollutant sources and loading and to more accurately represent the stream systems. The drainage area located in Alabama was represented on a coarser scale. This area was subdivided into 31 subwatersheds, in order to represent time varying flow and coliform loading into the Florida portion of the Choctawhatchee River. The waters at the Alabama/Florida border were not found to exceed Alabama's or Florida's water quality standards, but for modeling purposes the input from Alabama was assumed to be 200 counts/100 mL in order to represent the worst case scenario.

After the 18 subwatersheds were delineated in the lower Choctawhatchee watershed, reach networks within the model were established (e.g., width, depth, length, slope, elevations). For subwatersheds based on RF1 reach segments, reach characteristics were accessed from the RF1 database. Reach characteristics for RF3 reaches were estimated based on reach network, elevation and topography coverages. Stream cross-section dimensions, including width and depth, were developed using regional curves that relate watershed size to stream cross section (Rosgen, 1996). The functions used to estimate the stream depth and width of the RF3 reaches are:

$$d = 1.4995 * A^{0.2838}$$

where d is the stream depth in feet and A is the upstream watershed area in square miles, and

$$w = 14.49 * A^{0.40}$$

where w is the stream width in feet and A is the upstream watershed area in square miles. Some reach characteristics were adjusted to result in appropriate flow output and model response.

5.3.3 Hydrologic Calibration and Meteorological Representation

The modeling time period was selected as 1985-1995, in order to represent a range of hydrologic and climatic conditions. After developing the model to represent source contributions and in-stream response, the model was calibrated. The first step was to calibrate hydrology. Hydrology calibration involved comparison of modeled flow to observed flow at USGS gage 02361000 (Choctawhatchee River near Newton, AL) for 1987. This gage is located in a nearby watershed, which drains into the Choctawhatchee watershed and was assumed to be representative of hydrologic conditions throughout the Choctawhatchee drainage area. The year 1987 was selected because it represents a full range of hydrologic conditions.

The overall water balance, flow during storm events, and seasonal flow balance were examined. Various hydrologic parameters representing infiltration, interflow, groundwater, storage, and evapotranspiration were adjusted to match modeled flows with existing flows. The simulated flows are plotted with the observed flows in Figure 5-1. In addition to visual comparison, statistical comparison were made between daily model output and existing flow data. Results of the data comparison are presented in Table 5-1. As indicated in Table 5-1, the differences between simulated flows and existing flows are generally within recommended ranges.

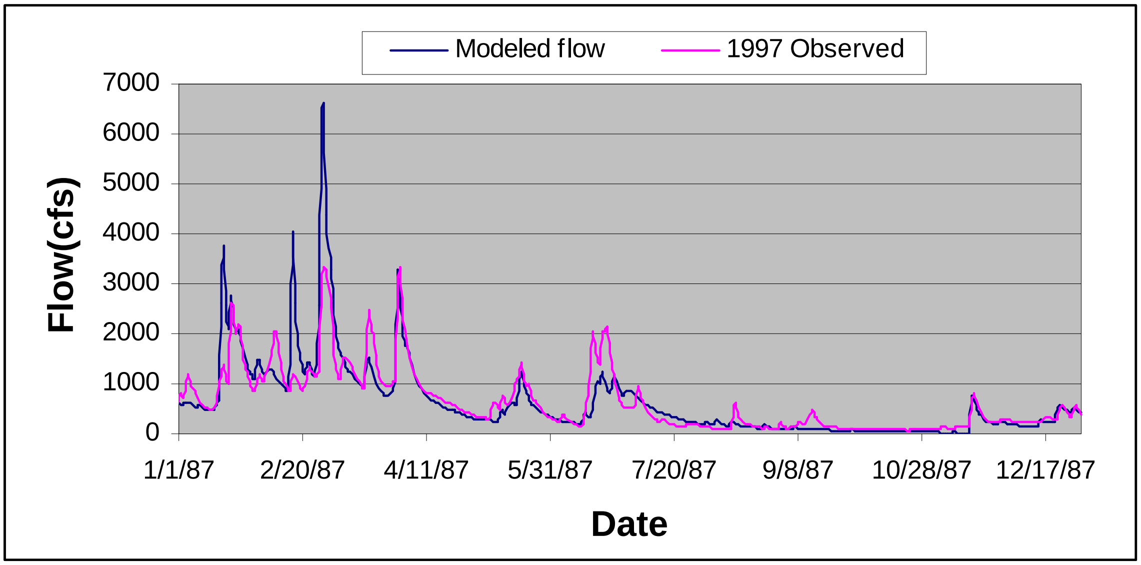

Figure 5-1. Observed and modeled flows at USGS gage 02361000, Choctawhatchee River near Newton, Alabama for 1987

Table 5-1. Results of data comparison of simulated and observed flows (in cfs) within the calibration watershed.

Calculation	Simulated	Observed	Error	Recommended Error [a]
Total flow volume	419.91	422.86	-0.7%	10 %
Total of lowest 50% of flows	50.63	59.93	-18.38%	10 %
Total of highest 10% of flows	162.89	138.61	14.91%	15 %
Summer flow volume	39.02	37.11	4.88%	30 %
Fall flow volume	28.35	35.65	-25.75%	30 %
Winter flow volume	250.30	219.61	12.26%	30 %
Spring flow volume	102.24	130.49	-27.63%	30 %

[a] Recommended error suggested in Lumb et al. (1994).

To represent the variability in weather throughout the Alabama and Florida portions of the watershed, multiple weather stations were used in the model. Weather station data form Montgomery WSO APRT, AL was applied to the Alabama subwatersheds while data from Wausau, FL was applied to the Florida subwatersheds. Data included hourly precipitation, air temperature, dew point, wind speed, solar radiation, and percent cloud cover for the period 1985 to 1995.

The hourly precipitation data contained various intervals of accumulated, missing, or deleted data. Accumulated data represent cumulative precipitation over several hours, but the exact hourly distribution of the data is unknown. Accumulated, missing, and deleted data records were repaired based on hourly rainfall patterns at nearby stations with unimpaired data. These intervals were patched using the *normal-ratio method*, which estimates a missing rainfall record with a weighted average from surrounding stations with similar rainfall patterns according to the relationship

$$P_A = \frac{1}{n} \left(\sum_{i=1}^{n} \frac{N_A}{N_i} P_i \right)$$

where P_A is the impaired precipitation value at station A, n is the number of surrounding stations with unimpaired data at the same specific point in time, N_A is the long-term average precipitation at station A, N_i is the long-term average precipitation at nearby station i, and P_i is the observed precipitation at nearby station i. For each impaired data record at station A, n consists of only the surrounding stations with unimpaired data; therefore, for each record, n varies from 1 to the maximum number of surrounding stations. When no precipitation is available at the surrounding stations, zero precipitation is assumed at station A. The US Weather Bureau has a long-established practice of using the long-term average rainfall as the precipitation normal. This method is adaptable to regions where there is large orographic variation in precipitation.

5.3.4 Source Representation

The nonpoint sources within the Choctawhatchee River watersheds are represented differently in the model depending on their type and behavior. The following nonpoint sources have been identified within the listed watersheds:

- General land-based runoff
- Grazing livestock
- Wildlife
- Failing septic systems
- Cattle in the stream reaches

Typically, nonpoint sources are characterized by buildup and washoff processes: they contribute bacteria to the land surface, where they accumulate and are available for runoff during storm events. These nonpoint sources can be represented in the model as land-based runoff from the land use categories to account for their contribution to coliform loading within the watersheds. Fecal coliform accumulation rates (number per acre per day) can be calculated for each land use based on all sources contributing coliform to the surface of the land use. For this study, where specific sources were identified as contributing to a land use, accumulation rates were calculated. For example, grazing livestock and wildlife are specific sources contributing to land uses within the watershed. The land uses that experience bacteria accumulation due to livestock and wildlife include

- Cropland (wildlife)
- Forest/Vegetated (wildlife)
- Open Land (wildlife)
- Pasture (livestock and wildlife)
- Wetlands (wildlife)

Accumulation rates were specifically calculated for these land uses based on the distribution of animals by land use for each subwatershed (see Section 4) and using typical fecal coliform production rates for different animal types (Table 5-2). For example, the coliform accumulation rate for pasturelands is the sum of the individual coliform accumulation rates due to contributions from grazing livestock (including milk and beef cattle, sheep, and horses) and wildlife.

Table 5-2. Fecal coliform production rates for various animals

Animal	Fecal Coliform Production Rate	Reference
Milk cow	7.1×10^{10} counts/day	ASAE, 1998
Beef cow	6.98×10^{10} counts/day	ASAE, 1998
Sheep	1.8×10^{10} counts/day	Metcalf & Eddy, 1991
Hog	8.9×10^{9} counts/day	Metcalf & Eddy, 1991
Deer	5×10^{8} counts/day	Linear interpolation; Metcalf & Eddy, 1991

Literature values for typical fecal coliform accumulation rates were used for the land uses—Urban, Residential, and Other. The literature value used for residential land uses is 1.43 E+07 #/ac/day, the average of the default values for low- and high-density residential areas (Horner, 1992). The literature value used for urban land uses is the median default value of 6.19 E+06 #/ac/day for commercial land (Horner, 1992). It is assumed that the "other" land use is half the load from low-density residential, therefore, the value used to represent fecal coliform accumulation rates on other land is 5.14 E+06 #/ac/day.

Failing septic systems represent a nonpoint source that can contribute fecal coliform to receiving waterbodies through surface or subsurface malfunctions. The estimation of number of failing septic systems is discussed in Section 4.2.2. To provide for a margin of safety accounting for the uncertainty of the number, location, and behavior (e.g., surface vs. subsurface breakouts; proximity to stream) of the failing systems, failing septic systems are represented in the model as direct sources of fecal coliform to the stream reaches. Fecal coliform contributions from failing septic system discharges are included in the model with a representative flow and concentration, which were quantified based on the following information:

- Number of failing septic systems in each subwatershed (as discussed in Section 4.2.2).
- Estimated population served by the septic systems (average of county averages of people per household, obtained from 1990 Bureau of the Census data).
- An average daily discharge of 70 gallons/person/day (Horsley & Witten, 1996).
- Septic effluent concentration of 10^4 cfu/100 mL (Horsley & Witten, 1996).

The septic system contribution in the model inherently contains a margin of safety based on the assumption that all the fecal coliform bacteria discharged from failing septic systems reaches the stream. In reality, it is likely that only a portion of the bacteria will reach the stream after being filtered through the soil or after die-off during transport.

Cattle depositing manure directly into stream reaches also represent a direct nonpoint source of fecal coliform. The number of cattle producing and depositing fecal coliform in watershed streams at any give time were estimated, as discussed in Section 4.2.4. The cattle were then simulated in the model as direct sources of fecal coliform loads, with a representative flow rate (cubic feet per second) and load (counts per hour). The representative load was calculated based on the number of cows in the stream and the fecal coliform production rate for cows (Table 5-2). The flow was estimated based on the number of cows in the stream, the manure production rate of cows (ASAE, 1998) and the approximate density of cow manure.

5.3.5 Water Quality Calibration

After the hydrologic calibration was completed and sources were most appropriately characterized and represented in the model, the modeled in-stream fecal coliform concentrations were compared to available observed data. Parameters representing such processes as bacteria accumulation, bacteria storage, and interflow and groundwater concentrations were adjusted to calibrate modeled water quality to the observed ambient water quality data. There was a total of seven available water quality monitoring stations in the Choctawhatchee watershed. Modeled water quality was compared to existing data at station 32020001 in the watershed. This station was chosen for calibration because it was located on a listed segment, had data available during a portion of the modeling time period (1993-1995), and had some mix of baseflow and peak concentrations.

In some cases, there was some uncertainty concerning the temporal comparison of modeled concentration peaks and observed peaks. The observed water quality represents an ambient concentration from a grab sample and the modeled water quality represents daily average concentrations. If there is a storm event during the sampling day, the grab sample may reflect a concentration on the rising or falling curve of the pollutograph or the peak storm concentration. To confirm calibration of the model's water quality and to avoid overestimation of the concentration peaks, daily output from the model were compared to the observed ambient data. Figure 5-2 presents calibrated daily modeled fecal coliform concentrations and observed fecal coliform concentrations at station 32020001 for 1993-1995.

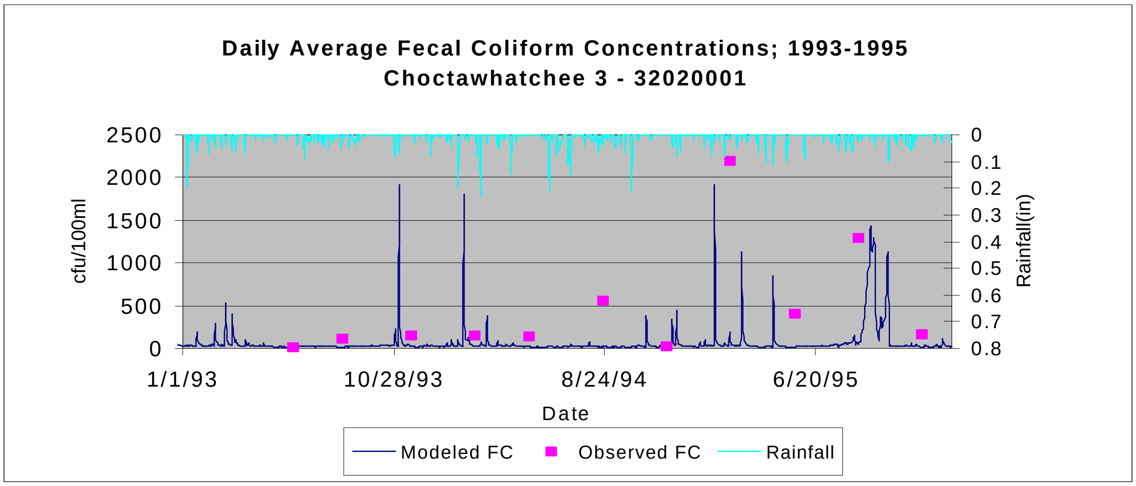

Figure 5-2. Daily modeled fecal coliform concentrations in Choctawhatchee subwatershed 003 and observed fecal coliform concentrations at Station 32030001

6.0 TMDL

This section presents the TMDLs developed for fecal coliform for the Choctawhatchee River watershed—Sikes Creek, the Choctawhatchee River (upstream segment), and the Choctawhatchee River (downstream segment). The TMDLs are presented on a 30-day basis. Model output for 1993 was used to determine the TMDLs and allocations scenario because modeled water quality during 1993 represented critical conditions during the modeling period. The years 1994 and 1995 also represented critical conditions, but were not chosen to determine TMDLs and allocation scenarios because of extreme weather conditions (i.e., tropical storm and hurricane) during these two years. The year 1993 was chosen to determine TMDLs and allocation scenarios because it was representative of more typical weather conditions. Allocations were determined on a 30-day basis for 1993 and represented compliance with the 200 counts/100 mL as a geometric mean standard (actually 190 counts/100 mL when considering the margin of safety). Figures D-1 through D-3 in Appendix D show the existing conditions and the allocated loads for Sikes Creek, the Choctawhatchee River (upstream segment), and the Choctawhatchee River (downstream segment).

The overall 30-day TMDL allocations are given separately for each watershed in the following tables. The contribution from each nonpoint and point source is specified and summed, giving the load allocation and wasteload allocation, respectively, which, when added to the explicit margin of safety, yields the TMDL.

6.1 CHOCTAWHATCHEE RIVER WATERSHED

6.1.1 Sikes Creek

The overall 30-day TMDL allocations for Sikes Creek are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Nonpoint Sources			
Cropland	7.36 E+12	0%	7.36 E+12
Forest/Vegetated	4.61 E+13	0%	4.61 E+13
Open Land	0.00 E+00	0%	0.00 E+00
Other	5.18 E+04	0%	5.18 E+04
Pasture	3.30 E+13	0%	3.30 E+13
Residential	1.07 E+10	0%	1.07 E+10
Urban	3.31 E+08	0%	3.31 E+08
Wetlands	8.23 E+12	0%	8.23 E+12
Failing Septic Systems	4.35 E+09	0%	4.35 E+09
Cattle in the Stream	2.60 E+11	0%	2.60 E+11
Total Existing Load	**9.5 E+13**	**Load Allocation**	**9.5 E+13**
Total Load Reduction = 0%		**Wasteload Allocation**	**0**
		Margin of Safety[1]	**4.6 E+12**
		Reserve for Future Growth/Activities	**3.90 E+11**
		TMDL = Loading Capacity =	**10.0 E+13**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and explicitly by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.2.

[2]A Reserve for Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.3.

6.1.2 CHOCTAWHATCHEE RIVER WATERSHED (UPSTREAM SEGMENT IN FLORIDA PORTION)

The overall 30-day TMDL allocations for the Chocatwhatchee River (upstream segment) are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Cropland	1.39 E+15	0%	1.39 E+15
Forest/Vegetated	7.99 E+15	0%	7.99 E+15
Open Land	3.58 E+10	0%	3.58 E+10
Other	3.14 E+13	0%	3.14 E+13
Pasture	8.29 E+16	0%	8.29 E+16
Residential	1.56 E+13	0%	1.56 E+13
Urban	2.21 E+11	0%	2.21 E+11
Wetlands	1.10 E+15	0%	1.10 E+15
Failing Septic Systems	7.16 E+10	0%	7.16 E+10
Cattle in the Stream	1.12 E+13	0%	1.12 E+13
Total Existing Load	**9.33 E+16**	**Load Allocation**	**9.33 E+16**
		Wasteload Allocation	**0**
		Margin of Safety[1]	**4.9 E+15**
		Reserve for Future Growth/Activities	**7.05 E+12**
		TMDL = Loading Capacity =	**9.82 E+16**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and explicitly by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.2.

[2]A Reserve for Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.3.

6.1.3 CHOCTAWHATCHEE RIVER WATERSHED (DOWNSTREAM)

The overall 30-day TMDL allocations for the Choctawhatchee River (downstream segment) are presented in the following table.

Source	Existing Loading Fecal Coliform (counts/30 days)	Estimated Percent Reduction	Allocated Load (counts/30 days)
Nonpoint Sources			
Cropland	4.86 E+13	0%	4.86 E+13
Forest/Vegetated	1.24 E+15	0%	1.24 E+15
Open Land	4.69 E+08	0%	4.69 E+08
Other	9.83 E+10	0%	9.83 E+10
Pasture	2.76 E+15	0%	2.76 E+15
Residential	2.54 E+12	0%	2.54 E+12
Urban	6.88 E+11	0%	6.88 E+11
Wetlands	5.86 E+14	0%	5.86 E+14
Failing Septic Systems	2.12 E+10	0%	2.12 E+10
Cattle in the Stream	2.00 E+12	0%	2.00 E+12
Total Existing Load	**4.64 E+15**	**Load Allocation**	**4.64 E+15**
Total Load Reduction = 0%		**Wasteload Allocation**	**0**
		Margin of Safety[1]	**2.3 E+14**
		Reserve for Future Growth/Activities	**1.10 E+13**
		TMDL = Loading Capacity =	**4.88 E+15**

[1] **Margin of Safety.** The MOS was included implicitly using conservative assumptions and by setting the water quality target at 190 counts/100 mL, 5% lower than the actual geometric mean water quality criterion of 200 counts/100 mL). See Section 6.2.

[2]A Reserve for Future Growth/Activities was calculated for watersheds with existing loads that did not exceed the target/endpoint of 190 counts/100 mL. See Section 6.3.

6.2 MARGIN OF SAFETY

The margin of safety (MOS) is a required part of the TMDL development process. There are two basic methods for incorporating the MOS (USEPA, 1991):

- Implicitly incorporate the MOS using conservative assumptions to develop allocations or
- Explicitly specify a portion of the total TMDL as the MOS using the remainder for wasteload and load allocations.

The MOS was incorporated both implicitly and explicitly in developing the TMDLs. Assumption made in simulating failing septic system loads is an example of implicit conservative assumption use din the modeling prosess).

The simulation of load contribution from failing septic systems assumes that all fecal coliform bacteria discharged by the failing systems reaches the stream. In reality, it is likely that only a portion of the bacteria will reach the stream after filtration through soil or surface die-off. Additionally, these discharges from failing systems are assumed to be constant throughout the year, while failures may actually occur less frequently.

To provide an explicit margin of safety, the water quality target for the TMDL was established at a geometric mean of 190 counts/100 mL for a 30-day period, which is 5 percent lower than the water quality standard of 200 counts/100 mL.

6.3 RESERVE FOR FUTURE GROWTH/ACTIVITIES

If the watershed's existing load to the watershed was found to be below the target/endpoint, which was the geometric mean water quality standard less the explicit margin of safety (190 counts/100 mL), then a "reserve for future growth/activities" was calculated. The reserve for future growth/activities is the amount of fecal coliform loading that can be contributed to the watershed on top of the existing loading without exceeding the target concentration of 190 counts/100 mL. The reserve for future growth was calculated by increasing the fecal coliform contributions from the most significant source in the watershed until the concentrations reached the target/endpoint. Figures D-1 through D-3 in Appendix D present the existing load and the reserve for future growth for each of the listed segments.

6.4 SEASONALITY

Seasonality was considered during the TMDL analysis through representatin of conditions thoughout an entire year. Seasonal differences in coliform levels could be caused by seasonal variations in precipitation and climate or by seasonal differences in activities in the watershed (e.g., land application of agricultural waste, recreational activities, etc.). Seasonality was evaluated using observed water quality and flow data. Water quality samples were collected quarterly at several monitoring stations in the watershed, providing coliform samples during different times of the year. These data do not suggest a distinct seasonal pattern of in-stream coliform levels, primarily becasue they do not provide consistent records of coliform levels during and across seasons and they do not have corresponding flow values. There is an apparent difference in flow volumes over seasons, indicating varying hydrologic as well as water quality conditions across seasons; although the seasonal differences do not consistently appear over the period of record for flow in the watershed. Although the modeling represented seasonal variation, the TMDLs were developed on a 30-day basis.

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Appendix A

Land Use Classification

Table A-1. Land use classifications in original land use coverages and their associated TMDL classification

Land Use Code	Description	TMDL Classification
	Florida classifications	
8110	Airports	Urban
2540	Aquaculture	Water
6110	Bay Swamps	Wetlands
7450	Burned Areas	Other
1480	Cemeteries	Open Land
1400	Commercial and Services	Urban
1860	Community Recreational Facilities	Urban
4410	Coniferous Plantations	Forest/Vegetated
1760	Correctional	Urban
2100	Cropland and Pastureland	Cropland/Pasture
6210	Cypress	Wetlands
7400	Disturbed Land	Other
1710	Educational facilities	Urban
8310	Electrical Power Facilities	Urban
8320	Electrical Power Transmission Lines	Urban
6440	Emergent Aquatic Vegetation	Wetlands
1600	Extractive	Other
2300	Feeding Operations	Pasture
4430	Forest Regeneration Areas	Forest/Vegetated
6410	Freshwater Marshes	Wetlands
1820	Golf Courses	Open Land
1660	Holding ponds	Other
1500	Industrial	Urban
6160	Inland Ponds and Sloughs	Water
6530	Intermittent Ponds	Water
1420	Junk Yards	Urban
5200	Lakes	Water
1740	Medical and Health Care	Urban
1730	Military	Urban
4340	Mixed Coniferous/Hardwood	Forest/Vegetated

Land Use Code	Description	TMDL Classification
1120	Mobile Home Units	Residential
1320	Mobile Home Units, High-Density	Residential
1220	Mobile Home Units, Medium-Density	Residential
2400	Nurseries and Vineyards	Forest/Vegetated
1640	Oil and Gas Fields	Urban
8170	Oil, Water, or Gas Transmission Lines	Other
1900	Open Land (Urban)	Open Land
2600	Other Open Lands (Rural)	Open Land
10	Outside Study Area	Other
1850	Parks and Zoos	Open Land
1800	Recreational	Urban
1720	Religious	Urban
5300	Reservoirs	Water
1300	Residential, High-Density	Residential
1100	Residential, Low-Density	Residential
1200	Residential, Medium-Density	Residential
7500	Riverine Sandbars	Other
8140	Roads and Highways	Urban
1620	Sand and Gravel Pits	Other
7200	Sand other than Beaches	Other
3200	Shrub and Brushland	Forest/Vegetated
5100	Streams and Waterways	Water
1610	Strip Mines	Other
1450	Tourist Services	Urban
8210	Transmissions Towers	Urban
8100	Transportation	Urban
2200	Tree Crops	Forest/Vegetated
4100	Upland Coniferous Forests	Forest/Vegetated
4200	Upland Hardwood Forests	Forest/Vegetated
6400	Vegetated Non-Forested Wetlands	Wetlands
6200	Wetland Coniferous Forests	Wetlands
6300	Wetland Forested Mixed	Wetlands
6100	Wetland Hardwood Forest	Wetlands

Land Use Code	Description	TMDL Classification
6900	Wetland Scrub Shrub	Wetlands
	MRLC classification	
41	Deciduous Forest	Forest/Vegetated
92	Emergent Herbaceous Wetlands	Wetlands
42	Evergreen Forest	Forest/Vegetated
23	High Intensity Commercial/Industrial/Transportation	Urban
21	Low Intensity Residential	Residential
43	Mixed Forest	Forest/Vegetated
11	Open Water	Water
85	Other Grasses (urban/recreational; e.g. parks, lawns)	Open Land
81	Pasture/Hay	Pasture
32	Quarries/Strip Mines/Gravel Pits	Other
82	Row Crops	Cropland
33	Transitional	Other
91	Woody Wetlands	Wetlands

Table A-2. Land use distribution within the watersheds of the 303(d)-listed segments

Land use	Choctawhatchee River, upstream segment (acres)	Choctawhatchee River, downstream segment (acres)	Sikes Creek (acres)
Aquaculture	0	2	0
Cemeteries	24	95	0
Commercial and Services	34	285	0
Communications	0	2	0
Communications Facilities	0	4	0
Community Recreational Facilities	0	0	0
Coniferous Plantations	18,330	46,353	2,741
Cropland and Pastureland	24,339	61,978	1,536
Cultural and Entertainment	0	9	0
Cypress	431	1,844	58

Land use	Choctawhatchee River, upstream segment (acres)	Choctawhatchee River, downstream segment (acres)	Sikes Creek (acres)
Disturbed Land	4	11	0
Educational facilities	0	58	0
Electrical Power Facilities	0	0	0
Electrical Power Transmission Lines	94	222	0
Emergent Aquatic Vegetation	23	108	0
Extractive	21	206	0
Feeding Operations	210	611	7
Forest Regeneration Areas	4,913	12,342	557
Freshwater Marshes	416	781	78
Golf Courses	0	123	0
Gum Swamps	94	94	5
Holding ponds	0	15	0
Industrial	0	65	0
Institutional	0	0	0
Intermittent Ponds	43	62	0
Junk Yards	9	50	0
Lakes	196	860	0
Medical and Health care	0	0	0
Military	0	0	0
Mixed Coniferous/Hardwood	19,292	43,827	1,867
Mobile home units	0	0	0
Mobile home units, high density	0	9	0
Mobile home units, medium density	0	3	0
Nurseries and Vineyards	43	71	0
Oil, Water, or Gas	0	36	0

Land use	Choctawhatchee River, upstream segment (acres)	Choctawhatchee River, downstream segment (acres)	Sikes Creek (acres)
Transmission Lin			
Open Land (Urban)	0	0	0
Other Recreational	17	19	13
Outside Study Area	69	69	0
Parks and Zoos	0	3	0
Recreational	12	12	0
Religious	35	99	2
Reservoirs	1,063	2,491	64
Residential, high density	3	155	0
Residential, low density	1,773	5,075	89
Residential, medium density	313	1,329	12
Riverine Sandbars	38	43	0
Roads and Highways	0	481	0
Sand and Gravel pits	2	49	0
Sand other than Beaches	0	3	0
Sewage Treatment	0	0	0
Shrub and Brushland	2,933	6,175	295
Slough Waters	0	24	0
Solid Waste Disposal	0	46	0
Specialty Farms	0	39	0
Stream and Lake Swamps	3,741	12,558	171
Streams and Waterways	798	1449	1
Strip Mines	7	52	0
Transmissions Towers	0	14	0
Tree Crops	194	352	0
Upland Coniferous Forests	7,000	16,997	981
Upland Hardwood Forests	62	272	0
Water Supply Plants	0	27	0

Land use	Choctawhatchee River, upstream segment (acres)	Choctawhatchee River, downstream segment (acres)	Sikes Creek (acres)
Wetland Coniferous Forests	48	142	5
Wetland Forested Mixed	9,825	33,984	1,903
Wetland Hardwood Forest	1,515	6,549	263
Wetland Scrub Shrub	2,060	4,774	180
TOTAL	**100,025**	**263,409**	**10,830**

Appendix B

Water Quality Data

The following table presents the data used for the evaluation of the water quality in the Choctawhatchee River watershed.

STATION	LOCATION	DATE	FECAL COLIFORM COUNTS PER 100 MILLILITERS
32020011	Choctawhatchee River Hwy 90	3/2/82	250
		12/3/89	100
		6/3/90	50
		12/2/90	30
		6/2/91	500
		12/1/91	500
		6/7/92	70
		12/5/92	170
		6/6/93	20
		8/15/93	20
		11/21/93	80
		2/20/94	130
		5/8/94	90
		8/21/94	1000
		11/20/94	20
		2/19/95	825
		5/21/95	400
		8/20/95	70
		11/19/95	260
		2/18/96	320
		5/19/96	50
		8/25/96	40
		11/24/96	80
		2/23/97	1400
		5/13/97	100
32020001	Choctawhatchee River at Hwy 2	6/3/90	400
		12/2/90	10
		6/2/91	200
		12/1/91	170
		6/7/92	130
		12/5/92	260
		6/6/93	10
		8/15/93	120
		11/21/93	150
		2/20/94	150
		5/8/94	145
		8/21/94	560
		11/20/94	30
		2/19/95	2200
		5/21/95	400
		8/20/95	1300
		11/19/95	160
		2/18/96	160
		5/19/96	90
		8/25/96	20

		11/24/96	120
		2/23/97	4100
		5/13/97	80
32020002	Wrights Creek Hwy	12/4/86	170
		2/25/87	120
		12/3/89	380
		6/3/90	500
		12/2/90	1000
		6/2/91	680
		12/1/91	10
		6/7/92	150
		12/5/92	90
		6/6/93	10
		8/15/93	30
		11/21/93	10
		2/20/94	90
		5/8/94	70
		8/21/94	160
		11/20/94	1200
		2/19/95	1075
		5/21/95	200
		8/20/95	190
		11/19/95	30
		2/18/96	20
		5/19/96	30
		8/25/96	140
		11/24/96	20
		2/23/97	380
		5/13/97	220
305057085513801	Sikes Creek at CR 179	12/9/92	122
		3/10/93	120
		8/12/93	300
		2/16/94	40
		5/18/94	200
		8/23/94	270
305127085454501	Wrights Creek at Hwy 177A	4/22/92	116
		7/22/92	134
		10/20/92	240
		11/17/93	80
		2/16/94	80
		5/18/94	120
		8/23/94	260
		3/14/95	58
		6/13/95	110
		8/15/95	360
		10/16/95	60
305531085405301	Tenmile Creek ab. Wrights Creek	1/16/92	800
		4/22/92	64
		4/22/92	1
		7/22/92	156

		10/20/92	10
305700085503301	Choctawhatchee River ab. W. Pittman	1/16/92	2200
		4/22/92	810
		7/22/92	1
		7/22/92	800
		10/20/92	60
		12/9/92	1
		12/9/92	305
		3/10/93	65
		6/16/93	28
		8/12/93	370
		3/14/95	134
		6/13/95	26
		8/15/95	64
		10/16/95	92

Appendix C

Cattle and Septic Loading Rates used in TMDL Development for the Choctawhatchee River Watershed

Table C-1. Failing septic system fecal coliform loading rates used in TMDL development for the Choctawhatchee River watershed

Subwatershed	Fecal Coliform Rate (counts/hour)	Septic Flow (cfs)
Choctawhatchee 1	3173927.52	0.00031
Choctawhatchee 2	5140077.31	0.00051
Choctawhatchee 3	14128190.65	0.00139
Choctawhatchee 4	17414469.58	0.00171
Sikes 5	5954625.08	0.00059
Choctawhatchee 6	3763772.46	0.00037
Choctawhatchee 7	4887286.63	0.00048
Choctawhatchee 8	84263.56	0.00001
Choctawhatchee 9	3314366.79	0.00033
Choctawhatchee 10	3932299.58	0.00039
Choctawhatchee 11	14718035.58	0.00145
Choctawhatchee 12	8173565.56	0.00080
Choctawhatchee 13	13425994.29	0.00132
Choctawhatchee 14	1067338.46	0.00010
Choctawhatchee 15	3482893.92	0.00034
Choctawhatchee 16	2303204.04	0.00023
Choctawhatchee 17	4550232.38	0.00045
Choctawhatchee 18	17582996.71	0.00173

Table C-2. In-stream cattle fecal coliform loading rates used in TMDL development for the Choctawhatchee River watershed

Subwatershed	Load of Fecal Coliform (counts/hr)	Flow (cfs)
Sikes 5	356475000.00	1.04519E-06
Choctawhatchee 1	609063000.00	1.78578E-06
Choctawhatchee 2	849429000.00	2.49054E-06
Choctawhatchee 3	2250885000.00	6.59963E-06
Chctawhatchee 4	1802745000.00	5.28568E-06
Choctawhatchee 6	160923000.00	4.71829E-07
Choctawhatchee 7	398233500.00	1.16763E-06
Choctawhatchee 8	584619000.00	1.71411E-06
Choctawhatchee 9	2688840000.00	7.88373E-06
Choctawhatchee 10	633507000.00	1.85745E-06
Choctawhatchee 11	2916984000.00	8.55265E-06
Choctawhatchee 12	1189608000.00	3.48795E-06
Choctawhatchee 13	1232385000.00	3.61337E-06
Choctawhatchee 14	28518000.00	8.36153E-08
Choctawhatchee 15	166015500.00	4.8676E-07
Choctawhatchee 16	135460500.00	3.97173E-07
Choctawhatchee 17	530638500.00	1.55584E-06
Choctawhatchee 18	1879132500.00	5.50965E-06

Appendix D

Existing and Allocated Loads for the Choctawhatchee River Watershed

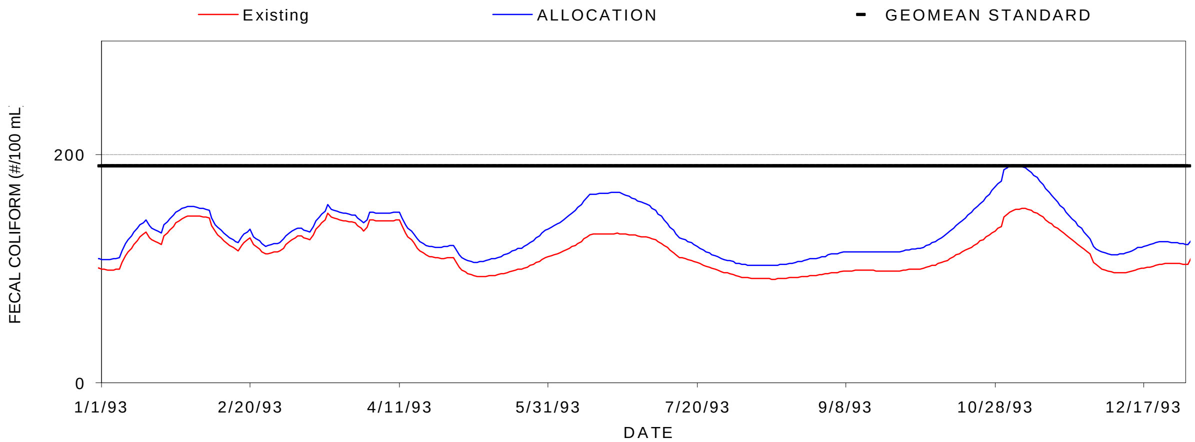

Figure D-1. Existing and allocated loads for the Sikes Creek watershed

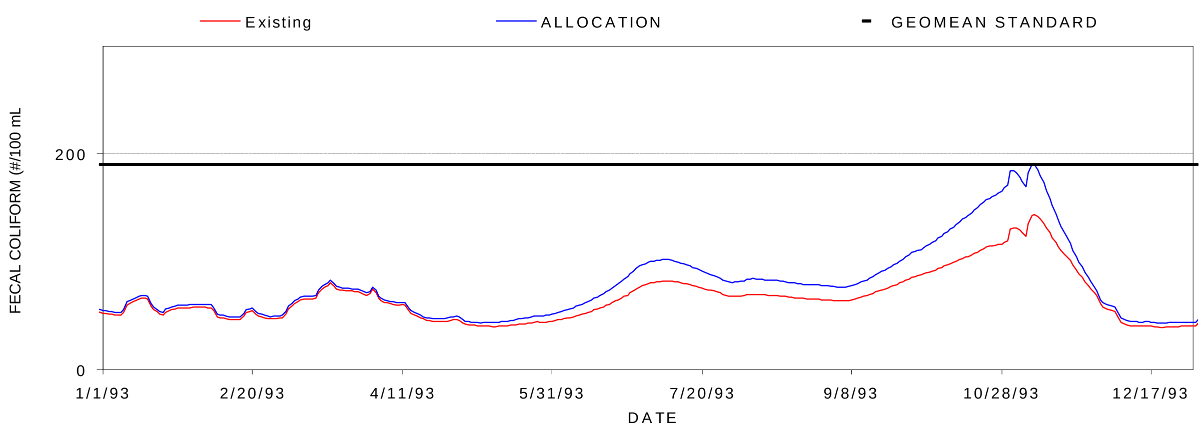

Figure D-2. Existing and allocated loads for the Choctawhatchee River watershed (upper segment)

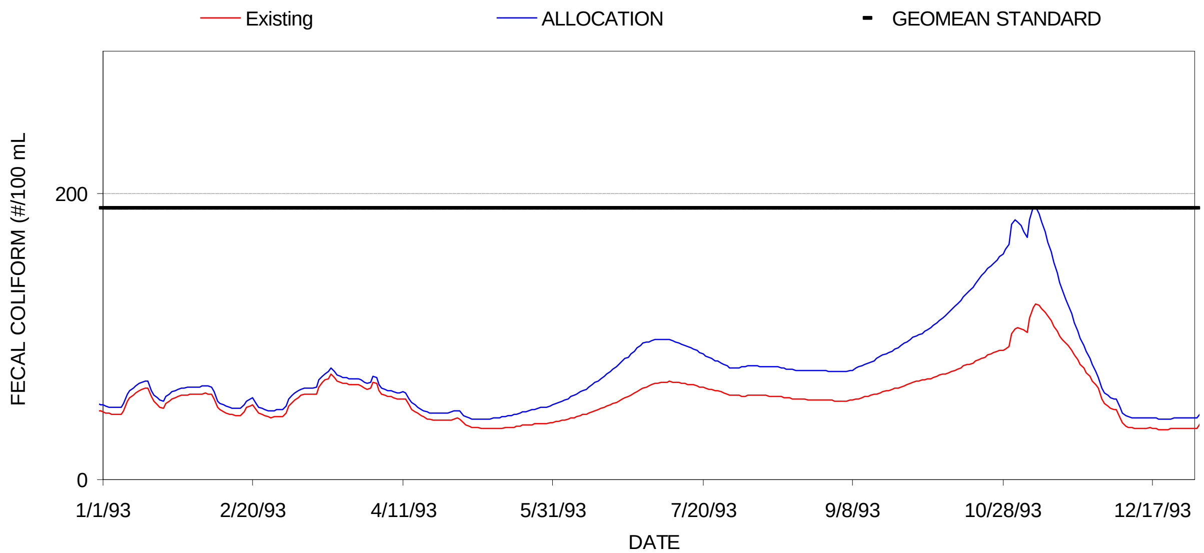

Figure D-3. Existing and allocated loads for the Choctawhatchee River watershed (downstream segment)